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GARTHWAITE (P. F.) & DESAI (M. H.). **On the Biology of the Parasites of the Teak Defoliators, *Hapalia machaeralis* Walk. (Pyralidae) and *Hyblaea puera* Cram. (Hyblaeidae) in Burma.**—*Indian For. Rec.* N.S. (Ent.) **5** no. 4 pp. 307–353, 7 figs. Delhi, 1939. [Recd. 1940.]

Of the insects that defoliate teak [*Tectona grandis*] in Burma, by far the most injurious are the Pyralid, *Hapalia machaeralis*, Wlk., and the Noctuid, *Hyblaea puera*, Cram., infestation by both of which causes considerable loss of increment to the trees. *Hapalia* has been recorded only from teak in Burma, but *Hyblaea* also attacks 17 other plants. Both these moths produce 13–14 generations a year, and their control by any but biological means is impracticable. A survey of their parasites is therefore being carried out with a view to increasing the efficiency of desirable species by biological and silvicultural means, and this paper constitutes a record of the data so far available. In all, 116 species of parasites are dealt with, but of these only about 35 have been specifically identified. Those bred from *Hapalia* and *Hyblaea*, respectively, comprise 47 and 29 primary parasites, of which 11 are common to both species, and 46 and 12 hyperparasites, of which 3 are common to both hosts and 2 also acted as primary parasites. A list of the parasites is given, showing their hosts and distribution in Asia, together with information on the bionomics of some of them. Included is *Cedria paradoxa*, Wlkn., which was introduced from India in 1937 against *Hapalia* [*cf. R.A.E.*, A **26** 339] ; between May 1937 and April 1938, 81,000 examples of this Braconid were bred in the insectary and released in 166 localities, from a few of which it was subsequently recovered [*cf.* **27** 693]. So far, it has not been recorded in Burma from a host other than *H. machaeralis*, though some of the alternative hosts recorded in India [*cf.* **22** 311] also occur there.

Apanteles machaeralis, Wlkn., accounts for 80 per cent. of the total parasitism of *Hapalia*, and in collections parasitised up to 26 per cent. of the larvae, though the percentage parasitism was usually much lower. For breeding it in the laboratory, a teak leaf bearing 50 first-instar larvae of *Hapalia* and a fresh teak leaf in water were placed on opposite sides of a glass breeding cage of which the door was replaced by a cloth sleeve ; a female parasite was then introduced, and as soon as each successive host larva was stung, it was transferred to the fresh leaf by means of a brush. Of 2,800 host larvae treated in this way, 45·5 per cent. yielded parasites, 41·5 per cent. died, and 13 per cent. developed normally, having escaped parasitism. The life-cycle from egg to egg lasted a fortnight, compared with 22–24 days in the host, and in the laboratory 19 generations a year were produced.

BEESON (C. F. C.). & CHATTERJEE (S. N.). **Further Notes on the Biology of Parasites of Teak Defoliators in India.**—*Indian For. Rec.* N.S. (Ent.) **5** no. 5 pp. 355–379. Delhi, 1939. [Recd. 1940.]

The data recorded in this paper on the parasites of *Hapalia machaeralis*, Wlk., and *Hyblaea puera*, Cram., which defoliate teak [*Tectona grandis*] in India, are supplementary to those published in papers already noticed [*R.A.E.*, A **24** 197] and to those obtained in Burma [*cf.* preceding abstract]. A brief account is given of the methods by which parasites were exchanged between India and Burma. Those shipped in 1937 and 1938 from Burma to Nilambur, Madras, comprised the Braconids, *Apanteles malevolus*, Wlkn., and *A. hyblaeae*, Wlkn.,

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and the Tachinid, *Zenillia* (*Carcelia*) *kockiana*, Tns., which parasitise *Hyblaea*, and *Trichogrammatoidea nana*, Zehnt., which attacks the eggs of both moths and was previously recorded as *Trichogramma* sp. [*cf.* **27** 612]. All were liberated in the field except *A. hyblaeae*. Those sent to Burma were the Ichneumonid, *Angitia* (*Dioctes*) *gardneri*, Cushm., and the Bethylid, *Goniozus montanus*, Kieff., which attack *Hyblaea*, and *Cedria paradoxa*, Wlkn., which attacks *Hapalia* and many other Lepidoptera [see preceding abstract]. A list is given of 23 Hymenoptera and 6 Diptera (including those imported from Burma) that are parasites or hyperparasites of *Hapalia* and *Hyblaea* in India, showing their hosts and distribution, together with notes on the bionomics of some of them.

A survey was made at Nilambur in 1937–38 of the parasites of *Hapalia* and *Hyblaea* on teak and of those of *Lygropia quaternalis*, Zell., on *Helicteres isora*, and *Sylepta* spp. on *Leea* and *Boehmeria*, all of which are grown as undergrowth in the teak plantations [*cf.* **26** 764]. The larvae of *Hapalia* were attacked by 17 parasites, of which *Cremastus hapaliae*, Cushm., was the most important; it parasitised up to 23·9 and 16·3 per cent. of the larvae in 1937 and 1938, respectively, and was frequently responsible for over 70 per cent. of the total parasitism. It was followed by *Apanteles machaeralis*, Wlkn., which parasitised up to 9·1 and 3·7 per cent. of the larvae in 1937 and 1938, and in April was responsible for as much as 45 per cent. of the total parasitism. *Hyblaea* was parasitised by only 6 species, of which *Sturmia inconspicuella*, Bar., was by far the most important and in 1937 was responsible for 84 and in some months for almost 100 per cent. of the total percentage parasitism, which ranged up to 86·6 per cent. In June 1938, however, it was supplanted by *Angitia gardneri*, which contributed nearly 90 per cent. of the total parasitism (46 per cent.). The larvae of *Lygropia* were attacked in 1938 by 26 parasities (the total percentage parasitism ranging from 29 to 49·6). *Lygropia* serves as an alternative host of 6 parasites of *Hapalia* and *Hyblaea*, a list of which is given, and the survey showed that its food-plant, *Helicteres*, may be regarded as having contributed 9 per cent. of the total percentage parasitism of *Hapalia* and 1·3 per cent. of that of *Hyblaea*. At least ten and four species of parasites, respectively, were obtained in July 1938 from larvae of *Sylepta* sp., probably *S. crotonalis*, Wlk., on *Leea* and those of *S. balteata*, F., on *Boehmeria*, the percentages parasitised being 32·1 and 40·5. The most important parasite of the former was *G. montanus*; *S. balteata* is an alternative host of *C. paradoxa*, but this species was not one of the four reared from it.

CHATTERJEE (P. N.). **On the Biology and Morphology of** *Apanteles machaeralis* **Wlkn. (Braconidae, Hymenopt.).**—*Indian For. Rec.* N.S. (Ent.) **5** no. 6 pp. 381–395, 1 pl., 7 refs. Delhi, 1939. [Recd. 1940.]

Apanteles machaeralis, Wlkn., is a solitary internal parasite of the teak defoliator, *Hapalia machaeralis*, Wlk., and is widely distributed throughout India and Burma. Descriptions are given of the egg, larva, cocoon and female genitalia of this Braconid, together with an account of laboratory observations on its bionomics carried out at Dehra Dun (United Provinces). Under normal conditions in May, the egg, larval and pupal stages of the host were completed in 2, 11 and 4

days, respectively, and those of the Braconid in May–June lasted 1, 5 and 3 days. Females attacked host larvae in the first three instars, and usually deposited one egg in each. In exceptional cases, the host was found to contain 3 eggs. The largest number of eggs deposited by a single female in one day was 28. Of 155 larvae subjected to parasitism and definitely punctured by the ovipositor, 84 escaped oviposition, but 20 of these died, possibly from the after-effects of the wound. The durations of the incubation and feeding periods were not affected by the instar of the host larva, but they were apparently prolonged to 7–8 days during the monsoon, when the temperature dropped to 80°F., and were reduced to 5 days in the hot season in May, when the temperature exceeded 95°F.

Several Ichneumonids and Chalcidoids (most of which are undescribed) were bred from cocoons of *A. machaeralis*; they included *Mesochorus indica*, Cushm., which is a solitary parasite, and *Elasmus* sp., which is gregarious. These hyperparasites feed on the full-grown larvae. There was practically no hyperparasitism in the field during May–July 1936, but in September–November most of the cocoons of *Apanteles* yielded hyperparasites.

The longevity of the adults of *Apanteles* was considerably prolonged at low temperatures; a female lived for 26 days and a male for 10 at 74°F., whereas at 80–90°F. females survived for only 2 days and males for 1 day.

SCHUILING (A. L.). **Enkele waarnemingen over het actieve verplaatsingsvermoegen van de Rhododendron-wants** *Stephanitis rhododendri* **(Horvath).** [Some Observations on the active Capacity for Displacement of the Rhododendron Bug, *S. rhododendri*.]—*Tijdschr. Plziekt.* **46** no. 2 pp. 83–86, 5 refs. Wageningen, 1940. (With a Summary in English.)

Although the rhododendron bug, *Stephanitis rhododendri*, Horv., has well-developed wings, it has been stated in the literature that its only method of spread is by migrating along the foliage and stems of plants that are in contact with one another [*cf. R.A.E.*, A **24** 550]. The author therefore carried out observations in Holland to ascertain whether this Tingid can also spread by flight. From them he concludes that on windless afternoons with a temperature of at least 21°C. [69·8°F.] the adults fly comparatively great distances and could easily migrate by this means to neighbouring bushes.

VAN DEN BRUEL (W. E.). **A propos de la lutte contre les mouches de la chicorée de Bruxelles** (*Napomyza lateralis* **Fall. et** *Ophyomyia pinguis* **Fall.). Efficacité du traitement à l'eau chaude.**—*Bull. Inst. agron. Gembloux* **8** no. 3–4 pp. 188–193, 1 diagr., 2 refs. Gembloux, 1939. (With Summaries in Dutch, German and English.) [Recd. 1940.]

It has been found possible in Belgium to produce perfectly sound heads of forced chicory [*Cichorium intybus*] from roots infested with larvae of *Phytomyza* (*Napomyza*) *lateralis*, Fall., and *Agromyza* (*Ophiomyia*) *pinguis*, Fall., provided that the larvae are killed before they can begin migrating to the leaves. As hot-water treatment of the roots before they are placed in forcing beds had appeared promising for this purpose, investigations on such treatment were continued

[*cf. R.A.E.*, A **26** 313]. They confirmed the conclusions of previous work that treatment at 40°C. [104°F.] for 1½ hours should ensure the production of sound heads by preventing movement of the larvae, although immersion for 1½ hours at 41°C. [105·8°F.] or for 2 hours at 40·5°C. [104·9°F.] did not give complete kills. In order to test in practice the results obtained in the laboratory, a batch of infested chicory roots was divided and submitted to treatments at 40–43°C. [109·4°F.] for ½–2½ hours. The roots were planted at the beginning of November and covered with earth and dead leaves, and examined at the end of February. This examination again showed that treatment at 40°C. must be maintained for 1½ hours to ensure the production of non-infested heads. Even at 42°C. [107·6°F.] 1 hour was insufficient, as was ½ hour at 43°C. Treatment for 1½ hours at temperatures of 40, 40·5 and 41°C. did not impair the quality of the heads.

VAN DEN BRUEL (W. E.). **Note sur le mode d'hibernation des mouches de la chicorée de Bruxelles** *Napomyza lateralis* **Fall. et** *Ophyomyia pinguis* **Fall. (Agromyzidae).**—*Bull. Inst. agron. Gembloux* **8** no. 3–4 pp. 223–230, 10 refs. Gembloux, 1939. (With Summaries in Dutch, German and English.) [Recd. 1940.]

In Belgium, chicory plants are lifted in October and November, and at this time they contain practically mature larvae of *Phytomyza* (*Napomyza*) *lateralis*, Fall., and *Agromyza* (*Ophiomyia*) *pinguis*, Fall., and also a few pupae and occasionally a small number of very young larvae. Observations were made in 1938–39 on the behaviour of the larvae during the winter and spring in roots that were not forced, but placed in clayey soil in the open. The main climatic features of the season were an abnormally warm period in January and February, preceded and followed by two very cold periods, and a sudden and unusually warm spring. The conditions favoured early emergence of adults. Both species were still represented by larvae on 22nd February. One-third of the larvae of *P. lateralis* had pupated by 29th March, and all the larvae had pupated by 13th April. Adult emergence of *P. lateralis* was first observed on 22nd May and of *A. pinguis* on 25th May, and emergence was completed by 3rd June. The experiment confirmed previous observations, that whereas larvae of *P. lateralis* are found all over the root, those of *A. pinguis* do not go below the root-collar [*R.A.E.*, A **21** 215]. In similar roots placed in a simple forcing bed, 60 per cent. of the larvae had pupated by 26th February. It appears from these observations that *P. lateralis* has only two generations a year, the hibernating larvae pupating in March and early April and adults emerging in May [*cf.* **25** 324], but this would not necessarily be true under different seasonal conditions. Adults of the summer generation fly in August, September and October. The possible variations in the duration of development, the length of adult life and the protracted oviposition period explain the simultaneous occurrence of young and mature larvae and pupae, and the length of the flight period of adults of the summer generation. Adults from pupae contained in débris of chicory plants that have been forced and those formed in autumn may emerge during the first warm days of March and early April. There are no chicory seedlings on which these early adults could oviposit, and it is thought improbable that the seedlings have sufficient tissue

deficient in chlorophyll to be attractive [*cf.* **25** 324] at the time of the main flight of the overwintered generation. Probably almost all adults of this generation oviposit on wild plants. Should this be confirmed by observation, the destruction of wild food-plants, such as *Matricaria, Senecio, Centaurea, Urtica* and *Anthriscus*, near chicory fields might prevent oviposition on the chicory by adults of the second generation, as they do not travel far. The wild food-plants of *A. pinguis* are unknown, but it is probable that the same conclusions also apply to this species.

Pests and Diseases in the Vegetable Garden.—*Growmore Bull. Minist. Agric.* no. **2** 26 pp., 4 pls., 8 refs. London, H.M.S.O., 1940. Price 6*d*.

This bulletin contains brief accounts of the common pests and diseases that affect vegetable crops grown in gardens and allotments in Great Britain, together with information on their control. Directions are included for the preparation and use of some of the more usual insecticides and fungicides.

Wilson (J. W.). **Preliminary Report on Wireworm Investigations in the Everglades.**—*Florida Ent.* **23** no. 1 pp. 1–6, 5 refs. Gainesville, Fla, 1940.

At least six species of wireworms occur in the Everglades (Florida), but the most prevalent is *Melanotus communis*, Gylh., and the investigations described in this paper were confined exclusively to it. It has caused serious damage to at least three of the major crops grown in the Everglades, sugar-cane, celery and peppers [*Capsicum*]. Observations suggest that the life-cycle can be completed in a year, but may sometimes require 18 months, and that all stages are likely to be found at any time. Three females collected in May laid a total of 123 eggs in the insectary, 85 of these hatched, with an incubation period of 12–17 days, and 28 of the larvae had moulted three times before 15th July.

Experiments on control with soil fumigants showed that the cost of an effective concentration would be completely prohibitive. Tests of foods that could be used in poison baits for the larvae indicated that oats, wheat, maize, potatoes, maize-meal, beans, cottonseed meal, flour and wheat bran were preferred in that order, but there were no significant differences between the first three. When, however, the wireworms were kept in jars with maize or wheat seed that had been treated with solutions of tartar emetic, thallium sulphate, potassium fluoride, or zinc phosphide or with maize seed that had been stored with para-dichlorobenzene or naphthalene, they fed on the grain and were not affected by doing so. No arsenicals were tried in these tests on account of Woodworth's experiments [*R.A.E.*, A **27** 28]. To test the theory that females of *M. communis* do not oviposit in land under certain cover crops, plots were planted early in April with velvet beans [*Stizolobium*], cowpeas, soy beans or weeds and grasses, or left fallow, and the wireworm populations were estimated then and again in October, after the plots had been ploughed. It was found that the number of wireworms had increased considerably in the plots planted

with weeds and grasses and with soy beans, but had decreased in the other plots. Susceptible crops subsequently planted in these plots were not damaged, but the number of wireworms per acre (10,000) in the most heavily infested plot was less than half the number that has been observed to cause serious injury.

WATSON (J. R.) & BRATLEY (H. E.). **Preliminary Report on Lubberly Locust Control.**—*Florida Ent.* **23** no. 1 pp. 7–10. Gainesville, Fla, 1940.

Previous observations [*R.A.E.*, A **27** 654] on the habits of the lubberly locust [*Romalea microptera*, P. de B.] in connection with the severe damage it causes to narcissus in Florida are recapitulated. As a result of the spring migration of the hoppers to the narcissus fields in 1939 [*loc. cit.*], the plants were black with them in late April, but when the narcissus died down and the bulbs were dug, they scattered in all directions, many returning to the field in which they had hatched. Mating was first observed about mid-June, and was soon followed by oviposition. The numbers of adults had decreased considerably by 1st August, though some could still be found near a river in October. Only one generation occurs each year. Pyrethrum sprays were found to be very effective against the hoppers, and the amount of spray required was not large if advantage was taken of their habit of remaining in clusters for a few days after they hatch or moult. The large numbers of hoppers and their continual migrations rendered the use of poisoned bran baits inadequate, but it was found that a trench about a foot deep made an effective barrier. On one isolated narcissus farm, they were effectively controlled by hand collection, which was facilitated by their habit of climbing plants when the temperature near the soil becomes high. Cultivation of the ground, including ditch banks and road-sides, in June prevents egg-laying. In addition to narcissus, *R. microptera* also attacked cowpeas, groundnuts, melons and lilies and caused appreciable damage to maize, particularly by destroying the silks and ends of the ears. For experimental rearing, it was fed largely on polkweed [*Symplocarpus foetidus*]. The hoppers did not attack narcissus bulbs stored in open sheds, but fed readily on any left in the field or exposed to rain.

BAERG (W. J.). **Termite Damage : Preventives and Remedies.**—*Bull. Ark. agric. Exp. Sta.* no. 385, 27 pp., 11 figs., 10 refs. Fayetteville, Ark., 1940.

This bulletin includes short accounts of the bionomics of subterranean termites, which are the only type to occur in Arkansas, and the damage caused by them to timber included in buildings, together with notes on the conditions rendering buildings liable to infestation and the measures recommended for its prevention and control. Those dealt with comprise structural methods that safeguard buildings by leaving no wood in contact with the ground, soil treatment, and the use of resistant and treated timber and metal shields [*cf. R.A.E.*, A **26** 748, etc.]. Specifications for the prevention of termite damage that have been incorporated into city building codes in the United States with satisfactory results are summarised, and very brief notes are appended on the habits and control of other insects that attack timber.

GARLICK (W. G.). **Notes on the Rose Stem Girdler,** *Agrilus communis rubicola* **Ab.**—*Canad. Ent.* **72** no. 2 pp. 21–23. Orillia, Ont., 1940.

The Buprestid, *Agrilus rubicola*, Abeille, is fairly widespread in southern Ontario, where it was first observed in 1931 and has been found infesting wild and cultivated roses, red raspberry, black and red currants and gooseberries. Damage to black currant, which is preferred to red currant or gooseberry, has been observed for some years, but has been erroneously ascribed to *Aegeria* (*Synanthedon*) *tipuliformis*, Clerck, and other borers. Injury is due almost entirely to larvae tunnelling in the woody stems [*cf. R.A.E.*, A **20** 408 ; **21** 96]. Galls appear on rose and less commonly on raspberry, but they are rarely formed on gooseberry, although short lengths of tunnel may occur as thin swellings on the surface. On currants, no galls have yet been found, and there is commonly no visible effect beyond the wilting and dying of the cane. The full-fed larvae apparently overwinter within the stem. In Ontario, adult emergence has been observed throughout almost the whole of June and the beetles have disappeared before mid-July ; in cages, they lived for about 3 weeks. They are most active during the hottest part of the day and prefer the warmest spots. In cages, they fed freely on the margins of black-currant leaves, and eggs were deposited singly on the smooth parts of the woody stems, chiefly those of the current year's growth. The larvae bored into the wood and pith, sometimes forming a regular spiral.

Parasites of this Buprestid were observed in 1937 in infested raspberry canes, an examination of canes at an outbreak centre showing a percentage parasitism of over 90. On 1st October, the tunnels were found to contain Hymenopterous larvae, pupae and adults, but several hundred infested canes collected in the autumn and placed under a darkened cage in the following spring yielded practically no parasites and very few beetles. To test the possibility of using sprays to destroy the beetles, two black-currant bushes were caged on 8th June and one was sprayed with Bordeaux mixture (1 : 6 : 40) containing lead arsenate (2 lb. per 40 gals.). Between 8th and 20th June, 120 beetles were placed in each cage. Later in the season, the unsprayed bush showed much ragged foliage and there were many eggs on it, whereas the sprayed bush showed no sign of injury and bore no eggs. Small-scale tests in the insectary confirmed these results. Whether the spray acted as a deterrent or a poison is not clear, and further investigations are being carried out to determine the most effective formula.

ROSS (W. A.) & HALL (J. A.). **The Rose Chafer.**—*Publ. Dep. Agric. Canada* 688 (Circ. 159) 4 pp., 1 fig. Ottawa, 1939. [Recd. 1940.]

This is a revision of a circular [*R.A.E.*, A **14** 349] on the Melolonthid, *Macrodactylus subspinosus*, F., the adults of which are a serious pest in southern Ontario, though the damage is confined to sandy districts, as breeding occurs only in sandy soil. The beetles, which are almost omnivorous and extremely voracious, gnaw holes in apples, peaches and other fruits, defoliate sweet cherry and peach trees, skeletonise strawberry leaves and destroy the flowers of garden plants. They emerge during June, most of them in the first half of the month, and pair shortly afterwards. Oviposition begins 5–6 days later, the eggs

being deposited in sandy soil, usually in grass lands and grain fields. The beetles are generally numerous for about three weeks, after which they die off rapidly. The larvae hatch in about 17–18 days, feed on the roots of grasses, cereals and weeds, and overwinter. Pupation occurs during the latter part of May. The larval population is commonly 100–200 per sq. yd., and may be as high as 1,000.

Satisfactory control requires the co-operation of all the growers in an infested district. The best measures are cultural, as there is abundant evidence that ploughing in late May and early June, ploughing and disking in July, and ploughing in late autumn destroy large numbers of the pupae, eggs and larvae, respectively [*cf.* **13** 577]. They should be supplemented by bringing neglected land under cultivation, supplying shade and substituting clovers for grasses. Spraying is effective on certain plants, but cannot give general control, owing to the omnivorous habits of the beetles. Grape vines and other plants that can be treated without risk of poisoning the fruit or spoiling the bloom should be sprayed as soon as the beetles appear with a mixture of 3 lb. lead arsenate, 1 gal. molasses and 40 gals. water: on vines, one or two additional applications may be necessary, according to the severity of the attack and weather conditions. The same spray, with the addition of 3 lb. hydrated lime, is tentatively suggested for use on apple, and one of 2 lb. zinc sulphate, 2 lb. hydrated lime, wettable sulphur (according to manufacturers' directions), $1\frac{1}{2}$ lb. lead arsenate and 40 gals. water for peach. The ingredients in the last spray are mixed into the water in the order given.

Barber (G. W.) & Dicke (F. F.). **Effect of Temperature and Moisture on Overwintering Pupae of the Corn Earworm in the Northeastern States.**—*J. agric. Res.* **59** no. 10 pp. 711–723, 3 refs. Washington, D.C., 1939. [Recd. 1940.]

In the north-eastern United States, a high percentage of the hibernating pupae of *Heliothis armigera*, Hb., which overwinter in the soil from about September to June, die before the spring [*cf. R.A.E.*, A **18** 583; **27** 430], and investigations were therefore carried out in Connecticut and Virginia from 1936 to 1938 on the effect of soil conditions on pupal survival.

The following is based on the authors' summary: Hibernation takes place usually at a depth of 2–4 ins. at the base of a sloping cylindrical tunnel, of which the walls are packed and lined with silk, which helps to keep the tunnel intact for long periods. It was found by means of a microvoltmeter that the freezing point of pupae kept in dry air is about 10°F. Analyses in December 1936 of hibernating pupae of *H. armigera* and larvae of *Pyrausta nubilalis*, Hb., which are more resistant to cold, showed that they contained 67·5 and 55·4 per cent. water and 13·7 and 20·8 per cent. fat, respectively. Hibernation indoors at room temperature or above it had little effect on the ability of the moths to emerge and caused little mortality, in spite of a slight loss of moisture. Normal soil humidity appears to be advantageous in maintaining a moisture balance; thus, pupae kept under dry conditions in a heated room lost 10 per cent. of their weight in a month, as compared with only 1·7 per cent. lost by pupae kept between moist paper towels in a cool room. Those submerged in water after having lost weight in dry air gained slightly in weight, probably

owing to absorption of water by the tracheal system and the exoskeleton. Pupae are able to float in flooded tunnels, and when placed in tubes partly filled with water, more than 50 per cent. floated and some of these survived for 20 days. About 20 per cent. remained submerged and died in less than 10 days, while the others floated and sank alternately. The percentage mortality among pupae in water increased with a rise in temperature; thus, among those kept for 10 days in water at 40 and 75°F., it was 16 and 80, respectively.

Observations on hibernating pupae placed in November 1936 on dry soil, moist soil or moist sand in an outdoor insectary in Virginia showed that the percentages that survived the winter were 27·4, 0 and 0. In the following season they were 52 and 1·3 on dry and moist sand, respectively. Pupae resting on wet soil are more susceptible to frost because of the greater thermal conductivity of moist soil, their greater content of water and a moist exoskeleton, which practically becomes fused to the soil when it freezes, allowing the body heat to be given up readily.

To determine whether pupae can survive lack of fresh air if their burrows are sealed with ice and the ground is frozen for weeks at a time, 60 pupae were placed singly in glass tubes of a diameter similar to that of the tunnels, but of 12 lengths ranging from 1½ to 12½ ins., with the ends corked and sealed with waterproof glue. The tubes were stored at about 40°F. on 9th October; on 5th May, two or more pupae were alive in all but the shortest of the tubes, and a total of 35 survived. Except in the shortest tubes, mortality was probably due to causes other than lack of air. Of 10 pupae placed in a refrigerator in small cups filled with water that was allowed to freeze gradually, one survived for 18 hours, but none for 24 hours.

BRUES (C. T.). **Food Preferences of the Colorado Potato-beetle, *Leptinotarsa decemlineata* Say.**—*Psyche* **47** no. 1 pp. 38–43, 6 refs. Cambridge, Mass., 1940.

The early history of *Leptinotarsa decemlineata*, Say, which is thought to be a native of Mexico and of which *Solanum rostratum* is considered to have been the original food-plant [*R.A.E.*, A **21** 494], is reviewed. As its sporadic occurrence on plants other than the most favoured food-plants, which cannot always be traced to the absence of potato in the immediate neighbourhood, may indicate the presence of separate strains or genetically distinct types, open-air experiments were begun in Massachusetts in 1923 in which adults were placed on 24 species of *Solanum* and on tomato (*Lycopersicum esculentum*). From the results of these preliminary tests, 9 species were selected for further experiments, and numerous larvae and some adults developed on all of them in field cages. In the following season (1924), beetles appeared on 5 of the 9 species, and in 1925, 2 of these, namely *S. rostratum* and *S. melongena*, produced adults. The failure of some of these species to support development for more than one or two seasons showed that the choice of a food-plant by the beetles is not always compatible with the larval food requirements. The relationship between the beetle and tomato was shown to be an even more pronounced case of mistaken instinct. Natural infestation of tomato by adults and larvae was reported from a garden near Cambridge, Mass., and part of the colony was transferred to healthy tomato plants

in a large screen cage for observation. The larvae continued to feed, but most of them died before becoming fully grown, and, though a few appeared to enter the ground to pupate, no adults appeared in the cages later in the season or the following year. Reference is made to observations by other workers of *L. decemlineata* feeding on tomato [**20** 239; **23** 388]. As it is unable to survive on tomato, natural selection will prevent the development of any strain attracted to this plant for oviposition.

HEINRICH (C.). **Some new American Pyralidoid Moths.**—*Proc. ent. Soc. Wash.* **42** no. 2 pp. 31-41, 12 figs. Washington, D.C., 1940.

Descriptions are given of five new species, including adults of both sexes of *Mineola supposita*, reared from larvae on *Cotoneaster* in British Columbia, and adults and larvae of *Alpheias conspirata* and *Ribua innoxia*, larvae of which have repeatedly been intercepted in the United States on pineapples imported from Mexico and Cuba, respectively. *Ribua* is a new Phycitine genus allied to *Plodia*; the pupal characters, as well as those of the adults and larvae, are given in the generic description. Observations by members of the Quarantine Division show that neither of the species intercepted on pineapples causes damage to them. *A. conspirata* appears to be a scavenger, feeding on dried particles of the fruit. According to J. M. Singleton, the larvae of *R. innoxia* were invariably associated with pineapples heavily infested with *Pseudococcus brevipes*, Ckll., and deposits of sooty mould growing on its honey-dew. They were at first thought to be predacious on the mealybug, but as they have not been found on pineapples infested by it unless the fungus is also present, it is more probable that they feed on the latter.

Larvae of another species or race of *Ribua* have several times been intercepted on pineapples from Porto Rico. Only two adults have been reared, and they are in too poor a condition to be described, but the male genitalia show what appear to be specific differences from those of *R. innoxia*.

JONES (S. C.). **Ethylene Dichloride seems to control Prune Root Borer.** —*Bett. Fruit* **34** no. 9 p. 7. Portland, Ore., 1940.

In view of the favourable results obtained in recent years in Georgia and Illinois from the use, even when soil temperatures were low, of ethylene dichloride emulsion [against *Aegeria exitiosa*, Say, on peach (*cf. R.A.E.*, A **27** 255, etc.)], preliminary trials were carried out in Oregon in October 1939 on its value against the Pacific peach and prune root borer, *Aegeria opalescens*, Edw. Gum exudates were removed from the experimental trees in a heavily infested peach orchard, the ground round the trees was levelled, and a 25 per cent. ethylene dichloride emulsion was used at the rate of ½ U.S. pint per tree. The average and maximum temperatures on the day of treatment were 45·9 and 65·4°F. The percentage mortalities obtained were 100 when the emulsion was poured on the bark round the trunks of the trees, beginning at the upper limit of the infestation, and the trees were mounded immediately after treatment, 78·6 when it was applied as a spray and the trees were mounded, and 60·7 when the trees were sprayed but not mounded.

PARKER (R. L.) & WENGER (O. E.). **The Juniper Midge,** *Contarinia juniperina* **Felt, a Pest of Red Cedars.**—*J. Kans. ent. Soc.* **13** no. 2 pp. 46–50, 2 figs., 3 refs. Manhattan, Kans., 1940.

Studies were begun in February 1939 on the bionomics and control of *Contarinia juniperina*, Felt [*cf. R.A.E.*, A **28** 67], which had been injuring the terminal growths of trees of red cedar (*Juniperus virginiana* and *J. chinensis*) in various localities of Kansas since 1935. All stages are briefly described. Overwintering larvae were collected in moist soil beneath the trees at a depth not exceeding 2 inches, but there were many in the twigs, between the dead end and the live portion, in February 1939, and a few in the middle of March. The first pupae were found in the soil on 23rd March, about half the larvae had pupated a week later, and no larvae could be found by 15th April. Adults were first collected on 25th April from the trees, they were abundant four days later and were practically absent on 20th May. Oviposition was first observed on 7th May during the early evening when humidity was rather high. The eggs were laid on the young growth near the middle of the needle on the part of the epidermis that faces the supporting branch.

In experiments made on 30th March on the treatment of soil in which the Cecidomyiids were hibernating, complete control was effected in soil covered with needles to a depth of $\frac{1}{4}$ in. and in bare soil by the three substances tested. These were a 20 per cent. ethylene dichloride emulsion prepared according to the standard formula [**25** 237] at 1 U.S. pint per sq. ft., a 20 per cent. agitated mixture of dichlorethyl ether and water at $1\frac{1}{2}$ U.S. pints per sq. ft., and paradichlorobenzene at 1 oz. per sq. ft. hoed into the top $1\frac{1}{2}$ ins. of soil. The two liquids soaked the soil to a depth of $\frac{1}{4}$–$\frac{1}{2}$ in. From hibernating larvae collected in the soil and reared in the laboratory, 64 adults of *C. juniperina* emerged and 177 parasites, most of which belonged to an undescribed species of *Platygaster*. One was a female of a species of *Inostemma*. On 29th April and during early May, the species of *Platygaster* was observed in large numbers flying among the needles of the young growth.

CLEARE (L. D.). **Report on the Entomological Division for the Year 1938.**—*Divl. Rep. Dep. Agric. British Guiana 1938* pp. 75–78. Georgetown, 1940.

The Amazon fly [*Metagonistylum minense*, Tns.] continued to be of value as a parasite of *Diatraea saccharalis*, F., on sugar-cane in British Guiana in 1938 [*cf. R.A.E.*, A **26** 491]. In one field of the variety P.O.J. 2878, the percentage parasitism of *D. saccharalis* rose from 12·7 to 80 between 23rd May and 29th June, while the rate of infestation by this species fell from 58·7 to 16·7 per cent., and that by *D. canella*, Hmps., increased from 7·5 to 9·3 per cent.

In 8 plant fields examined during June, the rates of infestation by *D. saccharalis* and *D. canella* were 17·8 and 34·0 per cent., respectively, and the percentage parasitism of *D. saccharalis* by *M. minense* was 16·6; in a ratoon field on the same plantation, the corresponding percentages were 8·8, 36·2 and 7·2.

An outbreak of *Brassolis sophorae*, L., on coconut in Georgetown that began in October 1937 [*cf.* **27** 524] continued until about September 1938. Many instances of damage by *Scapteriscus vicinus*,

Scud. (*didactylus*, Latr.) to garden and market garden crops were reported. The mole crickets were controlled by baits of bran and Paris green.

GEIJSKES (D. C.). **Voorraadsinsecten van rijst in Suriname met aanwijzingen ter bestrijding.** [Pest of stored Rice in Dutch Guiana, with Directions for Control.]—*Bull. Dep. Landb. Suriname* no. 55, 36 pp., 1 pl., 2 graphs, 6 tables, 7 refs. Paramaribo, 1940.

The investigations described were carried out in view of a severe outbreak of pests that occurred in May and June 1938 in stored rice at New Nickerie, a rice export harbour in Dutch Guiana. Samples were taken of unhulled rice in heaps on the floor, hulled rice in bags, and rice bran on the floor or fresh from the hulling mills. In all, 33 samples were taken from a number of different sites, and the insects bred from them comprised 4 primary pests (which alone caused noticeable damage), 12 secondary pests, 4 predators and 2 parasites. A list of these is given, showing their world distribution and habits, and tables show their occurrence in the various samples. Unhulled rice was damaged by *Calandra* (*Sitophilus*) *oryzae*, L., *Rhizopertha dominica*, F., and *Sitotroga cerealella*, Ol., and hulled rice, which was less severely infested, by *C. oryzae*, *R. dominica* and *Oryzaephilus surinamensis*, L. The bran harboured all these primary pests, but *Tribolium castaneum*, Hbst., was more abundant in it than any other insect. The infestations are discussed at some length. Hulled rice is an artificial product to which only a few of the insects that attack unhulled rice can adapt themselves, and the drying of the latter before hulling drives away or destroys many insects. Newly hulled rice was found to be free from infestation, possibly owing to the cracking of infested grains and the consequent destruction of insect pests in them and to the high temperatures produced during milling. One sample of rice had a temperature of about 50°C. [122°F.] when taken directly from the mill, and no insects emerged from it during the six months in which it was kept under observation. The unhulled rice from which this sample was prepared was heavily infested. Infestation of hulled rice occurs usually in infested warehouses, or when it is stored together with unhulled rice and bran. In 1938, the months from January to May were very wet. Unhulled rice stored under conditions in which it absorbs moisture becomes a very suitable medium for insect development.

The measures recommended for the control of infestation are better conditions of storage for unhulled rice, the immediate storage of hulled rice in clean warehouses, and fumigation of hulled rice and bran with carbon bisulphide.

AUTUORI (M.). **Um interessante método de aplicação do bisulfureto de carbono na extinção de formigueiros.** [An interesting Method for fumigating Ants' Nests with Carbon Bisulphide.]—*Biologico* **6** no. 4 pp. 98–101, 1 fig. S. Paulo, 1940.

A description is given of a simple apparatus that was devised by Homero Pimentel in São Paulo, Brazil, for fumigating ants' nests with carbon bisulphide. It consists of a cylindrical metal container 2 ins. high and 4 ins. in diameter on the top of which is an aperture

stopped with a cork. Near the upper edge of the side is another opening with a short neck on which a length of rubber tubing is fitted. About 10 oz. carbon bisulphide is poured into the container, which is then corked, the loose end of the rubber tube is inserted into an entrance to a nest, and the fumigant evaporates slowly and penetrates into the nest. The container should be protected from the sun, so that the liquid does not evaporate too quickly. Details are given of a number of tests in which the apparatus was successfully used. In the case of large nests several entrances were fumigated at once.

MENDES (L. O. T.). **Os parasitas do " bicho mineiro das folhas de café "** *Leucoptera coffeella* **(Guér. Mén. 1842).** [The Parasites of the Coffee Leaf Miner, *L. coffeella*.]—*Rev. Inst. Café S. Paulo* **15** no. 155 pp. 6–12, 2 pp. refs. S. Paulo, 1940. (With a Summary in English.)

A list is given of the 32 species of parasites, all of which are Hymenoptera, that have been reared from coffee leaf-miners of the genus *Leucoptera*, showing the countries from which they were recorded. Of 353 parasites bred from coffee leaves infested by *L. coffeella*, Guér., at Campinas, Brazil, in June 1937, 267 were an undescribed species of *Orgilus*, while 50, 29, 5 and 2 were *Proacrias coffeae*, Ihering, *Closterocerus coffeellae*, Ihering, *Horismenus aeneicollis*, Ashm., and *Tetrastichus* sp., respectively. *P. coffeae* and *C. coffeellae* are well known as parasites of *L. coffeella* in Brazil.

MENDES (L. O. T.) & FRANCO (C. M.). **Influência do expurgo, com bisulfureto de carbono, na germinação de sementes de café** (*Coffea arabica* **L.).** [The Effect of Disinfestation with Carbon Bisulphide on the Germination of Coffee Seeds.]—*Bol. téc. Inst. agron. Campinas* no. 71, 33 pp., 1 fig., 16 graphs. S. Paulo, 1940. (With a Summary in English.)

The measure generally recommended in São Paulo for the treatment of coffee beans infested by *Stephanoderes* (*Hypothemus*) *hampei*, Ferr., is fumigation for 12–24 hours with carbon bisulphide at the rate of 3 fl. oz. per 10 cu. ft. The experiments described were carried out to determine whether this process affected the germinating power of coffee beans intended for planting. The results are given in detail in tables and graphs and show that the maximum quantities (in fl. oz. per 10 cu. ft.) of carbon bisulphide that may safely be used for a given exposure (in hours) were 1 for 24, 1·5 for 18, 2 for 15, 2·5 for 15, 3 for 9, 3·5 for 6 and 4 for 3. Coffee beans for planting should, therefore, not be treated by the usual method.

OGLOBLIN (A. A.). **Sobre la sinonimia del Mimárido parásito del gorgojo de Eucalyptus (Mymaridae, Hymenoptera).** [On the Synonymy of the Mymarid Parasite of the Eucalyptus Weevil.]—*Mem. Jardín zool.* **9** (1, 1938) pp. 143–144. La Plata, 1939. [Recd. 1940.]

The author briefly reviews the literature on the synonymy of *Anaphoidea nitens*, Gir. (*gonipteri*, Ferrière), the Australian Mymarid parasite of the eggs of eucalyptus weevils of the genus *Gonipterus* that has been introduced into South Africa and Argentina [*R.A.E.*,

A **17** 279; **18** 426; **19** 447]. He considers that *Patasson* (Wlk. 1846) is an earlier name for *Anaphoidea* (Gir. 1909), but that *nitens* should be referred to the genus *Yungaburra*, which was proposed for it by Girault (1933) in a privately published paper.

CHAUVIN (R.). **Sur l'élevage de** *Schistocerca gregaria* **dans la métropole.** —*Rev. Zool. agric.* **38** no. 7–8 pp. 65–74, 1 fig., 8 refs. Bordeaux, 1939. [Recd. 1940.]

A description is given of the technique by which *Schistocerca gregaria*, Forsk., was bred for experimental purposes in the laboratory at Paris. The cages used for phase *gregaria* were 25 × 22 × 15 cm. in size, made of sheet iron, and with three sides of wire-gauze. It is recommended that hoppers should be kept at a temperature of 28–30°C. [82·4–86°F.] by day and 20°C. [68°F.] by night, and adults at 33–34°C. [91·4–93·2°F.] and 25–27°C. [77–80·6°F.], respectively, except during pairing, when a further increase to 40°C. [104°F.] by day and 28–30°C. by night is advisable. Mortality among hoppers is not more than 4–5 per cent., but 60–70 per cent. may be lost owing to cannibalism. Under laboratory conditions in Paris, it is not possible to keep the same stock indefinitely, for development becomes slow after 20–25 generations and epidemics of *Bacillus* (*Micrococcus*) *prodigiosus* and *Aspergillus* occur [*cf. R.A.E.*, A **26** 591]. Fresh stocks usually breed very rapidly; in one case, hoppers from adults obtained from Mauretania became adult in 24 days and sexually mature in another 10.

Phase *solitaria* should be bred singly in small cages (8 × 6·5 × 4·5 cm.), but even under such conditions not more than 17 per cent. of the progeny become typical ph. *solitaria*.

La protection des céréales contre la mouche de Hesse par la méthode de l'enfouissement.—*Rev. Zool. agric.* **38** no. 7–8 pp. 74–79. Bordeaux, 1939. [Recd. 1940.]

The experiments described were carried out in Morocco to determine the depth to which puparia of *Mayetiola destructor*, Say, aestivating in the stubble of cereals [*cf. R.A.E.*, A **26** 640] must be buried to prevent the emergence of the adults from the soil. The tests were made in summer and autumn, and the infested stubble was buried in pots in the laboratory or under cages in the open in three different types of soil at depths varying from about 1 to 10 ins.; in some of the laboratory tests, the soil was kept dry, and in others it was watered. The numbers of adults that emerged were compared with those from infested stubble left on the surface of the soil. From the results, which are tabulated, it is concluded that burying to a depth of 2 ins. is sufficient to prevent adult emergence from sandy soil. In leaf-mould with particles not exceeding 2 mm. in size, 10 per cent. of the flies made their way out from depths of 4–5 ins., but none appeared from stubble buried deeper. When the particles measured up to 10 mm., 10 per cent. of the flies emerged from depths of about 7 ins., but none from greater depths. Very few adults emerged from depths greater than 4 ins. in clay soil, but the presence of cracks in it facilitated emergence, and in one instance 40 per cent. emerged from a depth of 4 ins. in clay of which the particles measured 5–20 mm. The date at which the stubble was buried did not affect the mortality, provided that it was buried before the adults started to emerge in the autumn.

The Hymenopterous parasites of *Mayetiola* [*cf.* **28** 497] emerged from the buried stubble in numbers proportionate to those of the host. In some cases, however, in which the puparia were buried in loose fine soil or in sandy soil, a few adults of *Trichacis remulus*, Wlk., and *Eupelmella* appeared, but none of *M. destructor*.

Review of the Year 1939. Plant Protection.—*Mon. agric. Bull. Palestine* January 1940 pp. 64–65. Jerusalem, 1940.

Very brief notes are given on entomological work in Palestine in 1939. Considerable damage was caused to *Citrus* on the coastal plains by an unidentified species of *Pseudococcus*, which was declared a pest under the Plant Protection Ordinance. Chemical measures were required to supplement the control of the woolly apple aphis [*Eriosoma lanigerum*, Hsm.] by *Aphelinus mali*, Hald. [*cf. R.A.E.*, A **27** 127].

Rivnay (E.). **Studies in the Biology and Ecology of** *Retithrips syriacus* **Mayet, with special Attention to its Occurrence in Palestine.**—*Bull. Soc. Fouad 1er Ent.* **23** pp. 150–182, 3 figs., 7 graphs, 1 map, 28 refs. Cairo, 1939. [Recd. 1940.]

An account is given of detailed laboratory observations in Palestine on the bionomics of *Retithrips syriacus*, Mayet, and all stages are fully described. The synonymy of this thrips is reviewed from the literature, and it is concluded that *R. aegyptiacus*, Marchal [*cf. R.A.E.*, A **26** 610] and *Stylothrips bondari*, Morg. [*cf.* **12** 225; **13** 232] are identical with it. It is widely distributed and has been recorded from a great number of plants, a list of which is given; those on which it was observed in Palestine include guava, myrtle, rose, quince, plum, walnut, grape vine, avocado, *Pistacia*, castor (*Ricinus communis*), and persimmon (*Diospyros kaki*), which appears to be the favourite food-plant. It feeds on the leaves and fruits, causing defoliation and shrivelling.

In breeding experiments, which were carried out in test tubes on leaves of myrtle, the life-cycle from egg to egg lasted 21–32 days at temperatures above 26°C. [78·8°F.], 39–48 days at 22–25°C. [71·6–77°F.] and 74–87 days at 17–21°C. [62·6–69·8°F.]. Details are given of the durations of the stages at various temperatures, and it is concluded that in Palestine the thrips probably has seven generations a year. The eggs are usually laid in the leaf tissue, but are sometimes affixed to the surface. The total numbers laid by females at the optimum temperature of 25–30°C. [77–86°F.] averaged about 50 (with a maximum of 80), and the average number deposited per day was 4–5. All unfertilised eggs gave rise to males.

Observations on the factors limiting the mass increase of the thrips showed that mortality among the eggs increases at temperatures above 30°C. or below 19°C. [66·2°F.] and that lack of humidity was also detrimental. Many eggs that had almost completed their development at a favourable temperature did not hatch when transferred to cold conditions, and many larvae died during the process of hatching. Mortality of the larvae was very high at temperatures above 33°C. [91·4°F.] and at 14°C. [57·2°F.]; none pupated at 37°C. [98·6°F.] or 13·5°C. [56·3°F]. The larvae were fairly resistant to dry conditions, but some died at relative humidities above 95 per cent. Pupal mortality increased as the temperature rose above 33°C., and all pupae died at

37·5°C. [99·5°F.]. The rate of oviposition decreased at high and low temperatures, and no eggs were laid at 37·5°C. or below 17°C.

The fluctuations in the seasonal abundance of *R. syriacus* in Palestine are discussed. It is abundant in the autumn and scarce in winter, but all stages may occur in large numbers on some plants even as late as January if the rains are late. Many adults survive the winter, and as soon as there is a warm day, they abandon their shelters to feed and lay eggs. Of the latter, only a small number survive ; they hatch in late February or early March, and the resulting larvae give rise to adults about April. There is, however, no substantial increase in the numbers of the thrips, owing to the prevailing dryness of the atmosphere and the desert wind, which raises the absolute maximum temperature above 36°C. [96·8°F.], retards the development of the thrips and kills many of the eggs, until the end of June, when conditions become more favourable.

Few natural enemies have been recorded in the literature. *Franklinothrips myrmicaeformis*, Zanon [*cf.* **23** 411] was observed in the field in association with *R. syriacus*, and in the laboratory it fed on the eggs and pupae of the latter. The Trichogrammatid, *Megaphragma* (*Sethosiella*) *priesneri*, Kryger [*cf.* **28** 436] was reared from the eggs. Satisfactory control is given by two or three applications at intervals of 14–16 days of a spray of nicotine sulphate (1 : 800), which forms a film on the surface of the leaves and kills the larvae as they hatch. In laboratory experiments, over 98 per cent. of newly hatched larvae were killed by nicotine sulphate at 1 : 600. Since all stages of the thrips occur throughout the summer, no definite dates can be recommended for spraying, but it should be begun before infestation becomes severe.

PRIESNER (H.) **Contributions towards a Knowledge of the Thysanoptera of Egypt, XIII.**—*Bull. Soc. Fouad 1er Ent.* **23** pp. 352–363, 18 figs. Cairo, 1939. [Recd. 1940.]

Detailed descriptions are given of both sexes of four new species of thrips that occur in Egypt. They include *Haplothrips cerealis*, found in the Sinai Peninsula in ears of wheat ; females of a thrips stated to cause injury to the ears of wheat in Syria also probably belong to this species. Characters are given distinguishing it from *H. tritici*, Kurdj., with which it is likely to be confused ; neither has been taken in Egypt proper, but *H. tritici* has recently been recorded from wheat ears in Morocco.

ATTIA (R.). **The different Factors affecting the Temperature of a Heap of Grain in the Open.**—*Bull. Minist. Agric. Egypt* no. 192, 50 pp., 43 pls. Cairo, 1939. Price *P.T.* 10. [Recd. 1940.]

One of the chief methods of storing grain in Egypt is the shouna system, in which a small piece of land is fenced off and grain of different kinds is stored in heaps fully exposed to external conditions. Such grain is often infested by large numbers of insect pests, but wheat and barley, which are harvested in May or June, are not highly infested during June, July, and August. The author considers that this may be due to the shortness of the period during which they have been lying in the heaps. Maize and millet, which have already been lying in heaps for several months, are much more heavily infested. The scarcity of

insect pests in wheat and barley in June–August has also been attributed to the high temperatures prevailing during these months and to exposure to the direct rays of the sun. Investigations, a detailed description of which is given, were therefore carried out on the factors affecting the temperature of the grain.

A study was also made of the distribution of pests in heaps of grain, and in March 1932 a moderate sized heap of wheat was examined, samples being taken from the surface layer, from the layer 2–80 ins. deep, and from the heart of the heap (more than 80 ins. deep). The surface and intermediate layers were infested (in order of decreasing frequency) by *Calandra oryzae*, L., which was far more numerous than all the other insects together, *C. granaria*, L., *Rhizopertha dominica*, F., *Tribolium* spp., *Laemophloeus* spp. and *Oryzaephilus* (*Silvanus*) *surinamensis*, L.; no living insects occurred in the deepest layer. Of 2,000 grains from each layer, the percentages infested were 10·75, 10·65 and 1·25, respectively. The numbers of pests decreased as the depth increased, and the presence of infested grains at the lowest level, where no living insects were found, is attributed to infestation before the wheat was heaped or to the development of pests in it during the winter, when temperatures are more favourable. *Rhizopertha*, *Tribolium* and *Laemophloeus* are more resistant to heat than either species of *Calandra* and, unlike the latter, were more numerous in the intermediate than in the surface layer. The approximately equal infestation of the grains at these two layers indicated a recent migration of *Calandra* to the cooler surface layer with the advance of the hot season.

In early February 1933, a conical heap of over 200 bushels of infested wheat was exposed to the direct rays of the sun, and another was placed under a roof, but left uncovered at the sides; representative samples were taken 32 and 93 days after heaping. The results indicated that, with the approach of hot weather in May, the percentage mortality of both species of *Calandra* increased in the heap exposed to the sun, and the weevils began to migrate from the heap to cooler places. The percentage mortality of *Calandra* in the shaded heap was slightly lower, the rate of increase was greater, and there was probably no migration. *R. dominica* increased considerably in both heaps, indicating that conditions were fairly favourable for it, although its rate of increase was less in the unshaded than in the shaded heaps. As a result, the total number of living insects was about the same in May as in March in the unshaded heap, but was doubled, chiefly owing to the lower mortality of *Calandra*, in the shaded one; the percentage of infested seeds increased from 4·65 to 7·55 in the former and from 2·65 to 6·5 in the latter. It is concluded that in the vicinity of Giza and Cairo, heaping grain in the sun gives fair control of *Calandra* spp. from March to June, but that this is outweighed by the increasing numbers of *R. dominica*.

BODENHEIMER (F. S.). **The Ecology of Aphids in a subtropical Climate.**—*VI Congr. int. Ent. Madrid 1935* **1** pp. 49–58, 2 figs., 3 refs. Madrid, 1940.

Some of the observations made by the author during a period of 10 years on the ecology of Aphids in Palestine are recorded. The greatest abundance of individuals was in spring, coinciding with the main vegetation period, and the minimum was at the end of summer, the period of minimum vegetation. No cyclic migration was observed in

the case of many species that are certainly cyclic migrants in Europe. *Hyalopterus arundinis*, F., appears on both *Prunus* and reeds (*Phragmites* and *Arundo*) at the same time, and *Myzus* (*Phorodon*) *persicae*, Sulz., which is abundant on secondary food-plants, occurs only occasionally on *Prunus*. Common species that display no cyclic migration because their primary food-plants are absent in Palestine, or at least in the districts in which they are common, include *Aphis euonymi*, F., *A. fabae*, Scop., *Macrosiphum* (*Phorodon*) *solani*, Kalt., and *Amphorophora* (*Rhopalosiphoninus*) *lactucae*, L. *Eriosoma lanigerum*, Hsm., is confined to apple, as it is in Europe. It does not develop sexuales, and the winged viviparous females have only once been observed. *Phylloxera vitifoliae*, Fitch (*Peritymbia vastatrix*, Planch.) has no summer migration to the leaves of vines, and there are no leaf-galls.

On the other hand, certain Aphids that migrate between *Pistacia* and grasses are holocyclic in Palestine, though they have become adapted to anholocyclic development on grasses in northern Europe and Siberia, where *Pistacia* does not occur [*cf. R.A.E.*, A **17** 264, 397, etc.].

All these observations indicate the necessity for working out the life-history of every species on the spot.

[Kozhanchikov (I. V.).] Kozhantschikow (I. W.). **Die physiologische Charakteristik des Temperaturoptimums der Insektenentwicklung.** [The physiological Characters of the Vital Optimum Temperature of Insect Development.]—*VI Congr. int. Ent. Madrid 1935* **1** pp. 59–72, 22 refs. Madrid, 1940. (With a Summary in French.)

The author briefly reviews published work on the influence of temperature on the development of insects and recapitulates some of the results of his own investigations in 1930–35 on the vital optimum temperature [*R.A.E.*, A **22** 347; **23** 753; **24** 625, 702]. He concludes from them that the optimum temperature for insect development cannot be estimated solely from the rate of development, which is more rapid at the vital optimum only in the species that are the most completely adapted to thermal influences [*cf.* **23** 753]. Mortality, fertility and expenditure of energy must also be considered. A sum of effective temperatures established on a physiological basis indicates the limits of propagation of insect species.

Barnes (H. F.). **Fluctuations in Insect Numbers.**—*VI Congr. int. Ent. Madrid 1935* **1** pp. 181–186, 4 graphs. Madrid, 1940.

The author summarises and discusses the results of his study of the fluctuations in the populations of certain Cecidomyiids in England [*cf. R.A.E.*, A **24** 56, etc.]. He points out that the factors of importance in controlling their numbers are the relative durations of development and times of emergence of the midges and their parasites, and the adjustment between their development and the condition of their food-plants.

Pospelov [V.] (W.). **Fertility of certain obnoxious Lepidoptera in Connection with meteorological Conditions.**—*VI Congr. int. Ent. Madrid 1935* **1** pp. 195–202, 5 figs. Madrid, 1940.

The results of the investigation described in this paper have already been noticed from a summary [*R.A.E.*, A **27** 455]. Adults of

Loxostege sticticalis, L., that were kept at 35–42°C. [95–107·6°F.] and a relative humidity of 40–50 per cent. during the day and at 18–20°C. [64·4–68°F.] and 70 per cent. humidity by night (which approximate the conditions under which adults have been observed to be sterile in nature) and fed on sugar solution survived for about a month. Dissections of females showed that egg-maturation and exhaustion of the fat-body proceeded slowly, but no pairing or oviposition occurred. By the end of the period, the eggs in the lower part of the ovarioles had degenerated. The abnormalities induced in the reproductive organs of the males are described. Similar abnormalities were observed in males of *Agrotis* (*Feltia*) *segetum*, Schiff., kept at high temperatures and in those of *Pyrausta nubilalis*, Hb., and *L. sticticalis* taken in nature in hot weather.

García del Cid (F.). **Insectos bibliófagos y sus enemigos en las bibliotecas de Cataluña.** [Book Pests and their Enemies in the Libraries of Catalonia.]—*VI Congr. int. Ent. Madrid 1935* **1** pp. 399–404, 1 pl. Madrid, 1940.

The author describes and discusses the results of observations on insects that have caused injury to books in libraries in Spain. He points out that parchment and modern types of paper that are poor in cellulose are very little attractive to insects, and that the neglected state of many Spanish libraries has encouraged infestation. The chief case cited is that of the library of the University of Barcelona, where considerable damage was caused by the Anobiid, *Nicobium castaneum* var. *hirtum*, Ill. [*cf. R.A.E.*, A **23** 734] and *Lepisma saccharina*, L., which was far less abundant. Other pests that occurred, but caused negligible damage owing to their rarity, were the Bostrychid, *Psoa dubia*, Rossi, the Dermestid, *Anthrenus museorum*, L., the Psocid, *Liposcelis divinatorius*, Müll., and an unidentified Anobiid. The mite, *Pediculoides ventricosus*, Newp., was predacious on *N. castaneum* var. *hirtum* in books in a cellar, while the Bethylid, *Sclerodermus domesticus*, Latr., parasitised the larvae of this Anobiid in dry upper rooms. The larvae of the Bethylid, which are ectoparasitic, leave their host after about 20 days in order to pupate in some suitable shelter. The pupal stage lasts a little over a month, and the total life-cycle about 2 months. The infestation in Barcelona was controlled by fumigation with hydrocyanic acid gas. Other insects that also damaged books in libraries were *Borkhausenia pseudopretella*, Staint., at Santiago de Compostela and *Anobium punctatum*, DeG. (*striatum*, Ol.), which was parasitised by the Encyrtid, *Tineophoctonus armatus*, Ashm., at Cadiz.

Russo (G.). **Disinfestazione dei semi di cotone.** [The Disinfestation of Cotton Seed.]—*Agric. colon.* **34** no. 2 pp. 49–53. Florence, 1940.

An account is given of experiments on the treatment of cotton seed containing hibernating larvae of *Platyedra gossypiella*, Saund., carried out at Portici with infested seed obtained from Sicily [*cf. R.A.E.*, A **27** 174]. When the seeds were immersed in commercial sulphuric acid (66°Bé) for periods ranging from 5 minutes to 2 hours and then placed in water, only larvae in cracked or injured seeds were killed. The silky tissue sealing the larval chamber in uninjured seeds was not affected by the treatment and even resisted further immersion for 24 hours in pure sulphuric acid.

Fumigation with hydrocyanic acid gas was carried out in air-tight wooden boxes of a capacity of 1 cu. metre [about 35 cu. ft.], the gas being generated from sodium cyanide by means of dilute sulphuric acid. The fumigation period was 6 hours. When the cyanide was used at rates equivalent to 4, 5 and 6 oz. per 100 cu. ft. the percentage larval mortalities were 95, 100 and 100, provided that the seed was placed in layers not exceeding 4 ins. thick [*cf. loc. cit.*]. Very little or no control was given by fumigating seed in 12-in. layers or in heaps or bags. In tests with carbon bisulphide, in which the fumigation period was 24 hours, the percentage mortalities were 0 when the rate of application was 10 fl. oz. per 100 cu. ft., 74 at the top and 100 at the bottom of the fumigation chamber when it was 30 fl. oz., 96 at the top and 100 at the bottom when it was 40 fl. oz., and 100 at the top when it was 50 fl. oz. Fumigation was again ineffective when the seed was placed in layers more than 4 ins. deep, and with both fumigants the most satisfactory results are obtained by placing it on superimposed trays with wire screen bottoms [*loc. cit.*] ; a fan should be fitted for distributing the gases. In further tests, complete mortality of the larvae was given by immersing the seeds for half an hour in hot water at 50°C. [122°F.].

The germinating power of uninfested seed was somewhat increased by treatment with hydrocyanic acid gas, but was slightly reduced by carbon bisulphide.

[Selenkina-Bel'tyukova (K. N.).] **Селенкина-Бельтюкова (К. Н.). A brief Record of injurious Kitchen-garden Insects in the Okhansk Region (1936).** [*In Russian.*]—*Bull. Inst. Rech. biol. Perm* **11** no. 9–10 pp. 279–293, 12 refs. Perm, 1939. (With a Summary in English.) [Recd. 1940.]

Notes are given on the seasonal occurrence of a number of insects observed on vegetables in the spring and summer of 1936 in a district situated to the south-west of Perm. The chief pests were *Plutella maculipennis*, Curt., *Mamestra* (*Barathra*) *brassicae*, L., *Polia suasa*, Schiff. (*dissimilis*, Knoch) and *Brevicoryne brassicae*, L., on cabbage, *Phyllotreta* spp. on cabbage, rape and turnip, *Sitona lineata*, L., *S. crinita*, Hbst., *Macrosiphum onobrychis*, Boy. (*Acyrthosiphon pisi*, Kalt.) and *Cydia* (*Laspeyresia*) *dorsana*, F., on peas, *Ceuthorrhynchus jakovlevi*, Schultze, *Hylemyia antiqua*, Mg., and *Eumerus strigatus*, Fall., on onion, *Chaetocnema concinna*, Marsh., and *Phyllotreta undulata*, Kutsch., on beet, and *Psylliodes affinis*, Payk., on tomato. Peas were also attacked by larvae of the Lycaenid, *Everes argiades*, Pall., which fed on the young leaves and burrowed into the developing flower buds. They were fairly well developed in mid-June, when the peas were beginning to flower, and pupae and adults were observed on 24th June and about a week later, respectively. Larvae of the second generation were present in mid-July, but were rare on peas. The pupae hibernated.

Glover (P. M.). **Notes on the Biology and Larval Growth of** *Aphrastobracon flavipennis* **Ashmead (Braconidae).**—*Indian J. Ent.* **1** pt. 3 pp. 1–14, 1 fig., 11 refs. New Delhi, 1939. [Recd. 1940.]

Aphrastobracon flavipennis, Ashm., occurs in northern and southern India as a parasite of *Eublemma scitula*, Ramb., which is in the main a beneficial insect, since it is predacious on a large number of injurious

Coccids and only very rarely attacks *Laccifer lacca*, Kerr. The Braconid is also an occasional, but economically unimportant, parasite of *E. amabilis*, Moore [*cf. R.A.E.*, A **21** 131], one of the major predators of *L. lacca* throughout India, and its bionomics were therefore investigated at Namkum (Bihar), chiefly during 1933, to determine the possibility of increasing its importance as a parasite of this Noctuid. Adults were reared from parasitised larvae of *E. scitula* in domes [*cf.* **22** 310] collected in August–September 1933 from twigs infested by *Coccus* (*Lecanium*) *longulus*, Dougl. The immature stages, the rearing technique employed, and the processes of pairing and oviposition are described. The adults were fed on sugar solution. Males that emerged in October lived for an average of 62 days, and two females that also emerged in October and were prevented from ovipositing lived for 113 and 117 days, but four from which oviposition records were obtained survived for only 35–42 days. The females do not attack naked larvae, but oviposited fairly readily on tenth-instar larvae of *E. amabilis* that had spun webs over themselves in hollowed pieces of lac. Many of the larvae, however, were not rendered inactive by the neurotoxin injected before oviposition, which induces complete paralysis in *E. scitula*. In general, a single egg is laid in the gallery beside the host larva or on the larva itself. On two occasions, two eggs were deposited on a larva of *E. amabilis*, but only one of the parasites matured. Eggs laid by unfertilised females produced males only. An egg was deposited on a larva of *Platyedra gossypiella*, Saund., covered with tissue paper in a hollowed piece of lac, but the larva that hatched from it died in the fourth instar, and it is thought improbable that this species would be attacked under normal conditions. The mortality among first-instar larvae reared on *E. amabilis* was very heavy, as they were unable to attach themselves to the incompletely paralysed hosts. In view of this and the fact that the fertility of the females appears to be low, since the four from which oviposition records were obtained laid only 2, 2, 8 and 13 eggs, respectively, *A. flavipennis* is not considered to be of any potential importance as a parasite of *E. amabilis*. The average duration of the life-cycle on this host was 97·5 days.

Observations showed that the larval instars conform with Dyar's principle [*cf.* **17** 178], and that the length of the larval mandibles, which is identical in larvae and exuviae, increases in the same manner and by almost the same factor as head width [*cf.* **23** 153].

CHATTERJEE (N. C.). **Entomological Investigations on the Spike Disease of Sandal. A Summary Account of the Fauna obtained on Sticky Papers exposed in Sandal Forests with a List of suspected Vectors.**— *Indian J. Ent.* **1** pt. 3 pp. 15–24, 10 refs. New Delhi, 1939. [Recd. 1940.]

After briefly reviewing previous phases in investigations on the vectors of the virus of spike disease of sandal [*Santalum album*], which have been in progress in southern India since 1930, the author summarises the results obtained from a survey of insects during 1937–38. In 1930 and 1931, a large-scale survey of the insect fauna of sandal was carried out by means of bag-netting and beating, and some of the results of this have already been noticed [*R.A.E.*, A **22** 311, etc.]. Transmission experiments with common diurnal Rhynchota found on sandal were made without success during 1930–33, but it was

demonstrated that spike disease is transmitted by insects that can pass through a screen having 4 meshes to the inch, but not through one having 20. From October to December 1937 and from April to October 1938, papers smeared with an adhesive were exposed for a period of 3 weeks each month at heights of 2–8 ft. from the ground in two reserves in a sandal forest in Madras, to trap insects moving or carried by wind currents from the surrounding vegetation. The results are given in a table showing the numbers of examples of each Order, of each family of Rhynchota and of each species of Fulgoroids and Jassids that were taken.

Of upwards of 45 species of Jassids, 6 were recorded on sandal for the first time, and 13 have been observed in rank vegetation in various districts during October–December. In South India, spike disease is transmitted from infected to healthy plants during April–May and August–November, the incubation period being 7 months, although symptoms appear only 4½ months after artificial infection by leaf-grafting. The incidence of at least 26 species of Jassids coincides with the infective period, but some are eliminated since they occur in a district from which naturally transmitted spike disease has never been recorded, and other because of the negative results of transmission experiments. The remainder are all uncommon on sandal, and it is probable that the vector is a Jassid that does not ordinarily occur on sandal during the seasons of infection.

Negative results were obtained from transmission experiments with the four Fulgoroids taken, which included *Tambinia verticalis*, Dist., *Sarima nigroclypeata*, Melich., and *Eurybrachys tomentosa*, F. [*cf.* **22** 165, 311], and also with a species of *Macrosiphum*, which was the commonest Aphid caught on the sticky papers. Thysanoptera were taken in larger numbers than insects of any other Order and were represented by five species, but most of them can pass through a screen having 20 meshes to the inch. Sandal plants in experimental cages have been exposed for three years to the attacks of thrips from outside, but have not been infected, and special transmission experiments with thrips have also given negative results.

RAHMAN (K. A.) & NATH (R.). **The Black Bug of Sugarcane** (*Macropes excavatus*, **Dist., Lygaeidae : Heteroptera**).—*Indian J. Ent.* **1** pt. 3 pp. 25–34, 1 pl., 5 refs. New Delhi, 1939. [Recd. 1940.]

Ratooning of sugar-cane has become a common practice in the Punjab since the introduction of Coimbatore varieties in 1920, and this has favoured the increase of *Macropes excavatus*, Dist., which was first reported from the Kangra Valley in 1930 and has since been recorded from five other localities in the Province. Sugar-cane is the only plant on which this Lygaeid has been found in the Punjab and in Sind, where it was injurious in 1936, but it has also been recorded on rice and grasses in other parts of India. An account is given of investigations in 1933–37 on its bionomics ; the immature stages are described, and the original description of the adult is quoted.

Adult males and females lived for up to 112 and 118 days, respectively, in summer, and 210 and 242 days in winter. Pairing began 7–34 days after emergence. During the summer, the eggs are deposited in clusters of 14–67 on the inner surface of the sheathing base of the side leaves, but in winter they are laid singly, or occasionally in pairs, close to the roots of the plant at depths not exceeding 2–3 ins.

In the laboratory, the number of eggs laid by a single female varied from 55 to 478; between September and March a female deposited 322 eggs in 16 batches, and between May and September another laid 478 eggs in 12 batches. The eggs hatched in 9–17 days in May–September, 85–159 in October–January, and 23–35 in February–April. The five nymphal instars were completed in 38–52 days in March–July, 27–41 days in July–October, and 66–71 days in September–December. There are three generations a year. The adults pass the winter (October–March) in the soil round stumps of sugar-cane at depths up to 2–3 ins., where they feed and oviposit. The nymphs hatch in March and April, feed on the leaf-sap of ratooned cane, and until the end of May are the only stage present. From June until the end of October, all stages occur.

Both nymphs and adults congregate in the whorls of top leaves and under the sheathing bases of the side leaves and suck the cell sap, causing the leaves to appear chlorotic and seared; when infestation is severe, the leaves become pitted with holes. The bugs also secrete a foetid liquid that induces decay. Infestation causes the growth of the cane to be retarded and reduces the quantity and quality of the molasses.

Varieties of sugar-cane in which the sheathing bases of the side leaves are large and loosely attached are more severely infested than those in which they are closely applied to the stem. Between June and October, eggs on the inner side of the leaf bases are heavily parasitised by two recently described Scelionids, *Nardo cumaeus*, Nixon, and *N. phaeax*, Nixon; parasitism is especially severe from August until October (67–83·5 per cent.).

The discontinuance of ratooning is recommended as a preventive measure if conditions permit it. During March–April, nymphs collect in large numbers on the shoots from sugar-cane stubble; when the stubble was covered with trash and stripped leaves and burned during this period, the nymphs were completely destroyed and the stand and yield of the subsequent ratoon crop were good. A spray of 4 oz. nicotine sulphate, 16 oz. fish-oil soap and 20 gals. water applied against the young nymphs on sprouting ratoon cane during March–April gave 95–98 per cent. mortality.

Lal (K. B.). **Some New Species of Hymenoptera from India.**—*Indian J. Ent.* **1** pt. 3 pp. 49–58, 7 figs., 3 refs. New Delhi, 1939. [Recd. 1940.]

The seven new species described comprise four Braconids, two Bethylids and one Sphegid. All but one of them are associated with insects on sugar-cane, although the exact status as parasites of most of them has not been established. Two of the Braconids, *Stenobracon karnalensis* and *Rhaconotus roslinensis*, were parasitic on larvae of *Scirpophaga* sp. in northern India (Karnal) and Madras, respectively.

Rao (V. B.). **Three new Coccids from Baluchistan.**—*Indian J. Ent.* **1** pt. 3 pp. 59–63, 3 figs. New Delhi, 1939. [Recd. 1940.]

The new Coccids described are *Eriochiton amygdalae* and *Lepidosaphes baluchistanensis* on almond, and *Pulvinaria loralaiensis* on pistachio.

Infestation by *L. baluchistanensis* causes the bark to split and is followed by fungous attack.

CHERIAN (M. C.) & BASHEER (M.). *Noorda moringae* **Tams, a new Pyralid Pest of** *Moringa pterygosperma.*—*Indian J. Ent.* **1** pt. 3 pp. 77–82, 12 figs., 2 refs. New Delhi, 1939. [Recd. 1940.]

Two of the more important pests of *Moringa pterygosperma* in southern India are the Pyralids, *Noorda blitealis*, Wlk., and *N. moringae*, Tams, which attack the leaves and buds, respectively [*cf. R.A.E.*, A **26** 55, 405]. A brief account is given of the bionomics of *N. blitealis* for comparison with a more detailed one of those of *N. moringae*; the immature stages of both Pyralids and the adults of *N. blitealis* are briefly described.

Observations in April–May 1936 and August 1938 showed the egg, larval and pupal stages of *N. blitealis* to last 3, 7–15 and 6–9 days, respectively. The average and maximum longevities of adults fed on dilute honey were 11 and 33 days for females, and 8 and 20 for males. The maximum number of eggs laid by a single female was 232, deposited in 4 clusters. The injury caused by the larvae is greatest in March–April and December–January, when the trees may be defoliated. The larvae pupate in the soil in thin silken cocoons.

The eggs of *N. moringae* are generally laid in clusters, but sometimes singly. On hatching, the larvae move about actively in search of buds, into which they bore, feeding on the internal organs, but not on the outer petals; each bud contains only one larva. Infested buds fall to the ground, and the larvae pupate on or immediately below the surface of the soil in cocoons covered with soil particles. During June 1936 and July 1938, the egg, larval and pupal stages lasted 3–4, 8–16 and 6–10 days, respectively. The maximum and average longevities of adults were 30 and 17 days for males, and 24 and 15 for females, but they survived for only 6 days without food. Females oviposited 2–4 days after emergence, and in the laboratory deposited their eggs in clusters between the leaves on very young shoots of *Moringa*, or under the bark of dry stems. Three females laid 248, 110 and 93 eggs in 2 or 3 batches. The temperature and relative humidity during the months in which the life-cycle of the species were observed, and the percentage of buds containing larvae of *N. moringae* collected from trees during each month in 1936–38, are shown in tables. Infestation was generally lower during October–December. Larvae were rarely observed in buds smaller than 4 mm. in size, but as many as 78 per cent. of larger buds were infested. The percentage infestation of fallen buds in 1938 varied from 59·1 in January to 99·8 in June.

The larvae of *N. moringae* are parasitised by *Microbracon brevicornis*, Wesm., *Elasmus hyblaeae*, Ferrière, undetermined species of *Pristomerus*, *Chelonus*, *Perilampus* and *Systasis* and two apparently undescribed Braconids of the genera *Apanteles* and *Microbracon*. Little control is afforded, however, although *Apanteles* sp. is fairly numerous throughout the year.

Control of the larvae by insecticides would be difficult, as they remain inside the buds, and Bordeaux mixture was of little use as a repellent [*cf.* **26** 55]. The pupae can be destroyed by raking the soil round the trees.

PRUTHI (H. S.). **Ecology and Control of Insects.**—*Indian J. Ent.* **1** pt. 3 pp. 87–91. New Delhi, 1939. [Recd. 1940.]

This is a summary of the Presidential Address to be read before the Entomological Section of the 27th Session of the Indian Science Congress at Madras in January 1940. It comprises a discussion of some of the ways in which the intimate adjustment between animals and their surroundings, as a result of which any change in environment is followed by a marked change in their numbers, can be utilised in the control of insect pests, and is illustrated by reference to investigations by various workers on the influence of physical factors such as temperature, humidity and food supply, and biotic factors. B. P. Uvarov's work on *Dociostaurus maroccanus*, Thnb., in Iraq and Syria [*R.A.E.*, A **21** 627, etc.] is cited as providing an example of the combined influence of all environmental factors.

Short Notes and Exhibits.—*Indian J. Ent.* **1** pt. 3 pp. 93–99. New Delhi, 1939. [Recd. 1940.]

M. Singh (p. 94) states that *Gryllulus domesticus*, L., was observed in Delhi in May 1939 on young cotton plants. Both adults and nymphs attacked the young stems and leaves and were most active after dusk, sheltering at other times in holes in the ground about 4 ins. deep. In the laboratory, they also fed on cabbage, brinjal [*Solanum melongena*] and *Hibiscus*. B. Lall (p. 97) records two instances of damage by this Gryllid to American cotton in the Punjab in August–September.

K. A. Rahman (pp. 96–97) reports that the weevil, *Alcides porrectirostris*, Mshl., is very injurious to certain cultivated varieties of walnut in northern and north-western India at altitudes between 3,500 and 8,000 ft. The larvae bore into the kernels, reducing them to a black mass and causing the fruit to fall prematurely. Cherry trees in the Kulu Valley are attacked by larvae of the Cerambycid, *Aeolesthes holosericea*, F., which bore zig-zag tunnels in the stems, resulting in the exudation of chocolate-coloured resin. *Aphelinus mali*, Hald., which was introduced into the Punjab from England in 1937 for the control of *Eriosoma lanigerum*, Hsm., on apple, is well established in the Kulu Valley and on the Simla hills and has given very satisfactory results. It has about 14 generations a year, and during July–August the life-cycle lasts 11–15 days.

G. S. Sohi (p. 98) states that the leaves of fruit trees and roses in a recently planted garden in the Punjab are severely attacked from June to August by the adults of various Melolonthids and Rutelids that probably fed previously on wild plants, and also that parasites recently bred at Lyallpur comprise *Bruchobius laticeps*, Ashm., from *Bruchus chinensis*, L., *Cephalonomia tarsalis*, Ashm., from *Oryzaephilus* (*Silvanus*) *surinamensis*, L., and *Doryctes* sp. from *Lyctus africanus*, Lesne.

L. N. Nigam (p. 98) reports that during the rainy months of May and June 1939, adults of the Tenebrionid, *Mesomorphus villiger*, Blanch., were observed in large numbers in a house in Bihar, where they caused considerable annoyance at night and in dull weather by day. They fed on dead or decaying vegetable matter and, although they were attracted to light to a small extent, generally congregated in the chinks of door frames and windows.

P. M. Glover (p. 99) briefly describes the late larval and pupal stages of the Ichneumonid, *Goryphus nursei*, Cam., examples of which were observed [in Bihar] in April 1934 in the dome-like coverings constructed by larvae of *Eublemma scitula*, Ramb. [*cf. R.A.E.*, A **22** 310] beside the remains of the host larvae. Only one parasite occurred in each dome, within which the cocoon was spun ; two days elapsed between the beginning of spinning and the pre-pupal period, which lasted one day. The pupal stage of two males lasted 5 and 4 days, respectively. Three males caged in April lived for 9–15 days, and a female for 14 days.

RAHMAN (K. A.). **Important Insect Pests of Fruit Trees in the Punjab and their Control.**—*Punjab Fruit J.* **4** no. 13, 4 pp. [? Lahore] 1940.

Notes are given enabling the common insect pests of fruit trees in the Punjab to be identified from the appearance of the injurious stages and the type of injury caused. Brief recommendations for control are included, together with references to sources of more detailed information. Those dealt with are *Papilio demoleus*, L., *Phyllocnistis citrella*, Staint., *Dialeurodes citri*, Ril. & How., and *Diaphorina citri*, Kuway., on *Citrus* ; *Drosicha* (*Monophlebus*) *stebbingi*, Green, *Idiocerus* spp. and termites on mango ; *Virachola isocrates*, F., on pomegranate and guava ; *Euproctis* sp. and *Rhipiphorothrips cruentatus*, Hood, on grape vines ; *Anuraphis padi*, L. (*Brachycaudus pruni*, auct.) and *Dacus* (*Chaetodacus*) *zonatus*, Saund., on peach ; *Eriosoma lanigerum*, Hsm., and *Aspidiotus perniciosus*, Comst., on apple ; *Alcides porrectirostris*, Mshl., on walnut ; *Batocera rufomaculata*, DeG., on fig ; and *Oryctes rhinoceros*, L., and *Rhynchophorus ferrugineus*, F., on date palms.

RAHMAN (K. A.). **Spotted Boll-worms of Cotton.**—*Punjab agric. Coll. Mag.* **7** no. 1, pp. 3–5. Lyallpur, 1940.

Notes are given on the life-history and control of *Earias insulana*, Boisd., and *E. fabia*, Stoll, which are the only species of the genus that attack cotton in the Punjab, though *E. cupreoviridis*, Wlk., also occurs there. With the exception of Lahore, where only *E. insulana* is found, both species are present throughout the Province, *E. insulana* predominating in the Canal colonies, western Punjab and the greater part of central Punjab, while in the south-east and the remainder of central Punjab both species are equally abundant. In addition to cotton, *E. insulana* feeds on the flower buds and fruits of *Abutilon indicum*, hollyhock (*Althaea rosea*), *Hibiscus cannabinus*, *Malva* spp. and, occasionally, *H. esculentus*, which is the chief alternative food-plant of *E. fabia*. The life-history of these moths in the Punjab does not differ greatly from that recorded in Bombay [*R.A.E.*, A **24** 762]. Their most important parasite is *Microbracon lefroyi*, D. & G., which is fairly widely distributed and, where it is most common, is known to have parasitised 60 per cent. of the larvae. Measures recommended for control include picking and burning the infested shoots at the beginning of the cotton season, and dragging a rope over the plants, which causes infested flower buds and bolls to be thrown to the ground, where the larvae should be drowned by watering. During the off-season, all old cotton sticks should be removed from fields by cutting them 2 ins. below the ground, new shoots should be destroyed and wild food-plants eradicated.

Hutson (J. C.). **Report on the Work of the Entomological Division.**—*Adm. Rep. Dir. Agric. Ceylon 1938* pp. D36 – D41. Colombo, 1939. [Recd. 1940.]

The insect pests that occurred in Ceylon during 1938 included the following that have not been recorded recently [*R.A.E.*, A **24** 102, 765 ; **26** 358 ; **28** 96] : *Phycita leuconeurella*, Rag., on cashew nut (*Anacardium occidentale*) ; *Acanthopsyche subteralbata*, Hmps., on *Albizzia moluccana* ; *Noorda blitealis*, Wlk., on *Moringa pterygosperma* ; the Membracid, *Leptocentrus leucaspis*, Wlk., on *Vitex altissima* ; *Podagrica ceylonensis*, Jac., on *Hibiscus rosa-sinensis* ; *Pachydiplosis oryzae*, Wood-Mason, on rice ; and *Tenebroides mauritanicus*, L., *Sitotroga cerealella*, Ol., and *Calandra oryzae*, L., in stored rice.

Only one attack by *Nephantis serinopa*, Meyr., was reported on coconut on the western side of the island, and about 40,000 individuals of the Eulophid pupal parasite, *Trichospilus pupivora*, Ferrière, were liberated in the affected plantations during November and December. Apart from some small but severe infestations in the Batticaloa district, the east coast has remained remarkably free from *N. serinopa* [*cf.* **28** 97] ; this is due partly to the activities of five local indigenous parasites, assisted by *Trichospilus*, and partly to climatic conditions. On the western side, these five parasites are subsidiary to *Trichospilus*, which is also indigenous there and has been the dominant factor in controlling *N. serinopa* for many years. In the Batticaloa district, the same five parasites in the absence of *Trichospilus* do not afford satisfactory control ; *Trichospilus* has therefore been introduced and nearly 2½ million examples liberated [*cf.* **27** 638]. Surveys indicate that the parasite is becoming established in most of the areas in which it has been released.

A consignment of coffee berries containing *Stephanoderes hampei*, Ferr., and its parasites, *Prorops nasuta*, Wtstn., and *Heterospilus coffeicola*, Schmied., was received on 1st September from Uganda. Soon after their arrival, the few available examples of *Heterospilus* and about 220 of *Prorops* were liberated in a small area of heavily infested coffee. Later in the year, 530 examples of *Prorops* bred in the laboratory were released in the same area. A preliminary examination towards the end of the year gave no evidence that this Bethylid was becoming established.

A bait containing citronella oil, which attracts the males, served as an indicator of the seasonal prevalence of *Dacus ferrugineus*, F. [*cf.* **28** 45], but one of clensel attracted few flies of either sex. Gourds covered with bags of newspaper were protected from infestation by *Dacus* [*cucurbitae*, Coq.], but secondary rotting was more prevalent among the bagged fruit. Breeding and liberation of the imported parasites, *Spalangia* sp. and *Dirhinus auratus*, Ashm., was continued ; both remain established in cucurbit fields, though the percentage parasitism [of *D. cucurbitae*] is low, but again neither was recovered [from *D. ferrugineus*] in *Citrus* areas [*cf.* **28** 97]. Observations on *Cryptorrynchus mangiferae*, F., on mango indicate that the eggs are laid in quite young fruits, development takes place within the seed and the weevils emerge from the fallen fruits or discarded seeds.

During the first half of the year, preliminary trials were made with small local crops of lac insects [*Laccifer lacca*, Kerr] obtained from brood lac received from India. *Eublemma* [*amabilis*, Moore] and *Holcocera* [*pulverea*, Meyr.] caused some damage to the crop [*cf.* **24**

103], while heavy infestations by the ants, *Oecophylla smaragdina*, F., and *Crematogaster* sp., added to the difficulties of harvesting on some trees.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **51** pt. 2 pp. 102–106, 6 figs. Sydney, 1940.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **28** 513] includes very brief descriptions of all stages of the Saturniid, *Antheraea eucalypti*, Scott, the larvae of which usually feed on the leaves of *Eucalyptus* spp., but sometimes defoliate brush box (*Tristania conferta*) and pepper trees (*Schinus molle*), both of which are grown for ornamental purposes. The eggs are laid on the upper surface of the leaves in batches or short irregular rows. There are two generations a year, and pupation takes place in large silken cocoons in December and April. The pupae of the second generation hibernate. The cocoons are usually fixed to rough bark or in crevices, and sometimes to a twig. The larvae can be destroyed by a spray of lead arsenate (3 lb. per 100 gals. water).

Further work on the control of the bean fly, *Agromyza phaseoli*, Coq., has shown that the spray previously recommended [**26** 335] should contain a slightly higher concentration (1 : 640) of nicotine sulphate. The first application in any particular sowing should be made 2 days after the earliest plants show through the ground, the second should follow 3 days later, and any further ones at intervals of 4 days. In most areas, 6–8 applications are desirable on beans sown between January and mid-March, 4–6 on those sown in the latter half of March and 2–4 on those sown in April. Infestation is usually severe from the end of December until about the end of April along the central portion of the coast, or until about the end of May along the northern portion. Spraying at regular intervals is essential, as the spray destroys the eggs and larvae in the leaf-blades, but not the larvae in the leaf-stalks or the stems [*cf.* **28** 333]. Only the upper surface of the leaves should be sprayed, and about 40 gals. of spray are required per acre at each application.

The introduced Halticid, *Phyllotreta nemorum*, L., is widely distributed in New South Wales, where it usually feeds on cabbages and the foliage of turnips, but causes little damage.

Swan (D. C.). **The Lucerne Flea : Its Life History and Control in South Australia.**—*J. Dep. Agric. S. Aust.* **43** no. 6 pp. 462–471, 1 pl., 3 figs., 15 refs. Adelaide, 1940.

This paper on the life-history and control of *Smynthurus viridis*, L., on pasture and market-garden crops in South Australia is based on work over a number of years at the Waite Agricultural Research Institute and on the literature. *S. viridis* is the most destructive pest of clover and lucerne pastures in the wetter parts of the State [*cf. R.A.E.*, A **21** 407, 521, etc.] and also feeds on Cape weed (*Cryptostemma calendulaceum*), which is an undesirable constituent of pastures and a source of infestation, peas and other soft-leaved plants. Leguminous plants are preferred, but carrots, turnips and lettuce are attacked in market gardens, particularly as seedlings, and young barley, oats and wheat on heavy soils are sometimes damaged. The types of injury caused to lucerne and clover by *S. viridis* and *Halotydeus destructor*, Tucker, which occurs with it in many situations, particularly

on light soils, and may be the more injurious in such places, are briefly described, and the distribution of the springtail in Australia and New Zealand is summarised.

The eggs are laid on the surface of bare, damp soil, usually in the shelter of plants, in piles of 20–100 or more [*cf.* **20** 432] ; large masses probably contain the eggs of several females. The eggs develop only in the presence of moisture, and are coated with excreta, consisting mainly of soil previously swallowed for the purpose, which maintains a supply of moisture from the soil. The nymphs and adults also require a high humidity and occur only during the wet season, approximately from April to October. The eggs are the only stage to survive the summer ; they hatch in autumn, when the soil surface has been continuously moist for about a week. If the onset of the winter rains is early and temperatures are still high, the population may develop rapidly and damage autumn pasture. A hot summer may result in high mortality of eggs in exposed situations such as open pastures, and infestation in autumn then spreads from sheltered sites to pastures. Damage to young plants may be severe if they are grown after a cover crop attractive to *S. viridis* or where weeds have been ploughed in.

Though only eggs that have completed about half their development are able to withstand heat and desiccation [*cf.* **20** 556], an excessively wet soil surface is unfavourable and kills many eggs. On a normally wet soil surface, the rate of development is controlled by the prevailing temperature [**19** 600 ; **21** 348].

The only known natural enemy of *S. viridis* is the predacious mite, *Biscirus lapidarius*, Kramer, which was introduced into South Australia in 1933 [**22** 313] and was later found to occur there naturally in restricted localities. There is no evidence that this Bdellid exerts any appreciable control on *S. viridis* in this State. Cultural methods of control, including the cultivation of mixed pastures and the management of grazing stock, are discussed. During the establishment of a permanent pasture, damage by *S. viridis* may be extensive while the sward is still comparatively open and consists chiefly of clover, and spraying may be necessary. It is considered that lucerne should probably be grown alone in South Australia, but as it is liable to recurrent heavy infestation, a routine programme of mowing or grazing followed by spraying may be necessary. The cheapest and most effective spray is lime-sulphur, the application of which to pasture is discussed [*cf.* **21** 407]. In market gardens, it should be applied at a dilution of 1 : 50, with a spreader, to seedlings. Two applications, a week apart, will probably give protection until the plants are sufficiently developed. Borders should be cultivated round the beds, and weeds in them controlled, to prevent re-infestation from neighbouring areas.

Vacuum fumigation of the seed of subterranean clover [*Trifolium subterraneum*] against the eggs of *S. viridis* is carried out at Adelaide. The seed is exposed for 4 hours at a pressure of 28 ins. mercury below atmospheric pressure to carbon bisulphide applied at the rate of 25 lb. per 1,000 cu. ft. with an equal quantity of carbon dioxide to reduce the risk of fire. This rate of application is higher than that found necessary when winter eggs were fumigated at atmospheric pressure [**22** 448], but such fumigation is unsatisfactory on a commercial scale, and summer eggs, such as are found in seed impurities, are possibly more resistant.

Whyte (R. O.). Ed. **The Control of Weeds.**—*Herbage Publ. Ser.* Bull. 27, 168 pp., 24 pls. (1 col.) text illus. Aberystwyth, Imp. Bur. Pastures, 1940. Price 7*s.* 6*d.*

This symposium on the prevention and eradication of weeds on agricultural land contains three papers of entomological interest. In "Some Australian Weed Problems" (pp. 113–130), G. A. Currie includes notes on the introduction into Australia of insects to effect the biological control of noxious weeds. *Euaresta aequalis*, Lw. [*R.A.E.*, A **27** 546] has been liberated against Noogoora bur (*Xanthium pungens*), while another seed fly, *Camaromyia bullans*, Wied., is known to attack *X. spinosum* [*cf.* **18** 534] throughout the range of the plant. So far, all attempts to control *Hypericum perforatum* by means of insects have failed [*cf.* **27** 282]. The Tingid, *Teleonemia scrupulosa*, Stål (*lantanae*, Dist.), which was introduced from Fiji for the control of *Lantana* [*camara*] in 1936 [**26** 86], has made little or no progress in most of the areas in which it was liberated, but it appeared in vast numbers on about 24 acres of lantana near Atherton, Queensland, in the summer of 1938–39 [*cf.* **28** 317] and by May 1939 had defoliated many bushes and killed back some of the branches up to two feet.

In "The Biological Control of Prickly-Pear in Australia" (pp. 131–143), A. P. Dodd gives a list of the noxious species of *Opuntia* that occur in Australia, showing which are the more important, describes their spread throughout the Dominion, and outlines the organisation of the campaign against them. A list of cactus insects already established in the field is included; most of those introduced against *Opuntia inermis* and *O. stricta* also attack some of the lesser pest pears. Since 1937, success has mainly been due to *Cactoblastis cactorum*, Berg [*cf.* **27** 345; **28** 316]; the life-history of this Pyralid and the way in which it attacks *Opuntia* are described, and the present position, the control of the lesser pest pears and the reclamation of pear lands are reviewed.

In "Biological Control of Noxious Weeds in New Zealand" (pp. 153–157), D. Miller discusses the principles underlying the use of insects for the control of noxious weeds and gives a brief account of work in New Zealand [*cf.* **27** 449]. Although good results against ragwort (*Senecio jacobaea*) were at first given by *Tyria jacobaeae*, L., this Arctiid did not prove satisfactory, as it has only one generation a year, larval activity is restricted to a short period in the spring, and natural enemies suppressed it after a few years in all but one of the localities in which it was liberated. *Hylemyia* (*Pegohylemyia*) *jacobaeae*, Hardy [which is possibly the species recorded in a recent abstract (**27** 449) as *H. seneciella*, Meade] was therefore introduced into New Zealand and by 1938 had become established on ragwort over a large experimental area. This Anthomyiid overwintered successfully in the field in 1938 and infested the spring and summer flowers of the weed. Observations showed that all the seeds in an infested floret are destroyed. The imported sawfly, *Antholcus varinervis*, Spin., which was released against piri-piri (*Acaena* spp.), has maintained itself in the field for two seasons and has increased in numbers. Eggs are not deposited on the foliage of strawberry, which is the only important rosaceous crop plant in leaf in July, when the adults emerge and oviposit. The establishment of *Apion ulicis*, Forst., on gorse (*Ulex europaeus*) [*cf.* **20** 271, etc.] is proceeding on a large scale. In the plantations at

the Cawthron Institute, over 90 per cent. of the spring and summer seeds are destroyed, while a recent survey of the area of original liberation showed an infestation of 98·6 per cent. A considerable amount of gorse flowers in the colder months of the year, as well as in late summer, when the weevil does not oviposit, but comparatively little seed appears to develop in late summer.

JONES (S.). **A Visitation of the Spotted Locust** (*Aularches miliaris* **L.**) **in Travancore.**—*J. Bombay nat. Hist. Soc.* **41** no. 3 pp. 676–678, 1 pl., 7 refs. Bombay, 1940.

Isolated examples of *Aularches miliaris*, L., can normally be found in the plains and in the hilly districts of Travancore, but outbreaks are rare. One was reported about 18 years ago at Manimala, and in June 1939 serious damage was caused at Kalanjoor, in Central Travancore, by a swarm a quarter of a mile long and fifty yards wide, which completely defoliated a plantation of young teak and also attacked other trees, including coconut palms, mango, areca [*Areca catechu*], jak [*Artocarpus integrifolia*] and banana. The life-history of *A. miliaris* in Travancore is not known, and the details of it in Ceylon are quoted [*cf. R.A.E.*, A **14** 234]. For control, it is recommended to spray the young nymphs with soap solution, to dig up and destroy the egg-masses, and to collect the adults by hand.

FEYTAUD (J.). **Un redoutable ennemi des charpentes de pin et de sapin : le longicorne** *Hylotrupes bajulus* **L.**—*Rev. Zool. agric.* **38** no. 9–10, pp. 81–88, 1 fig., 5 refs. Bordeaux, 1939. [Recd. 1940.]

Hylotrupes bajulus, L., which occurs throughout Europe and infests chiefly coniferous sapwood in buildings, causes considerable damage to structural timbers in the region of Bordeaux, where the wood of spruce and pine is very commonly used for structural purposes. The egg, larva and adult of this Cerambycid are briefly described, and notes are given from the literature on its habits and life-history. In Bordeaux, pupation usually takes place at the end of the winter or beginning of spring, and the pupal stage lasts 3 weeks. The adults emerge from the wood in July and August, and survive for 2–3 weeks. The larval stage lasts 2–5 years. The number of exit holes made by the young beetles affords little indication of the severity of the infestation, as several adults often emerge from the same hole.

None of the substances, such as creosote, used to impregnate structural timbers to repel ovipositing females afford lasting protection, and the treatment should be periodically repeated. It is advisable to inspect the timber of buildings every 4–5 years. Where possible, control should consist in scraping of all damaged wood, and sound timbers should be whitewashed. The author has, however, eradicated moderate infestations in floors by introducing volatile liquids such as carbon bisulphide, carbon tetrachloride or benzine into the wood through holes drilled at intervals and stopped with a cork, or by brushing the infested wood with a mixture of carbon tetrachloride and paradichlorobenzene (1 : 1 or 2 : 1), while he has successfully dealt with severe infestations by injecting chloropicrin into beams and other structural timbers, and by spreading it on the floors of rooms, attics or lofts and closing them for 24–48 hours. The method of treating buildings with hot air [*R.A.E.*, A **21** 214] is briefly described.

Bruneteau (J.) & Vimeney (P.). **Essais de lutte contre** *Rhagoletis cerasi* **en Gironde.**—*Rev. Zool. agric.* **38** no. 9–10 pp. 88–93, 1 ref. Bordeaux, 1939. [Recd. 1940.]

Following experiments in south-western France in 1937 with bait-sprays and trap-glasses against *Rhagoletis cerasi*, L., on cherry [*cf. R.A.E.*, A **26** 526], further investigations were carried out in 1938 and 1939. In 1938, considerable reductions in infestation were given by a single application on 22nd May, 30th May or 10th June of a bait spray of 3 per cent. sugar solution containing 0·1 per cent. ammonium fluoride. Some of the deposit was lost owing to heavy rain, ripening of the cherries was retarded for about a week by the treatment, and, owing to wind, a powerful jet had to be used. Slight scorching of the foliage resulted, but no serious damage was caused. Most of the eggs were laid after 10th June, and some were observed on sprayed trees on 18th June ; it is considered that, for complete protection, three applications in June, the last about 25th, would have been required. In 1939, 0·4 per cent. sodium fluoride was substituted for the ammonium fluoride in the spray, and applications were made on 14th and 23rd June. Spraying on 14th was hindered by wind, and heavy rain fell on several days following 20th June. The control obtained was not so good as with ammonium fluoride in the preceding year.

In the tests with trap-glasses, about 30 traps baited with 10 per cent. sugar solution containing 2 per cent. ammonium fluoride caught 97 females and 26 males between 15th and 30th May 1938, and still more in the first fortnight of June. In 1939, 18 traps with the same bait caught 100 females and 38 males in the first half of June and 97 females and 83 males in the second half. The same number of traps baited with 10 per cent. sugar solution containing 0·5 per cent. sodium fluoride caught only 11 females and 4 males during the first fortnight of June. In general, the flies preferred sheltered sites on the trees, and more were taken in the shade and on the eastern side.

On the basis of these experiments, the authors recommend spraying with ammonium fluoride against *R. cerasi*. If the spring is dry, the flies appear earlier and the spray should be applied weekly from about the end of May until the end of June. The dates of spraying will vary according to weather conditions. On an average, about a gallon of spray is sufficient for one tree, and it should be applied so as to form fine droplets on the leaves.

Bartholomew (E. T.), Sinclair (W. B.) & Janes (B. E.). **Factors affecting the Recovery of Hydrocyanic Acid from fumigated Citrus Tissues.**—*Hilgardia* **12** no. 7 pp. 473–495, 1 fig., 10 refs. Berkeley, Calif., 1939. [Recd. 1940.]

Under certain conditions of fumigation against Coccids on *Citrus*, hydrocyanic acid is known to cause injury to the foliage and fruit. The physiological reactions involved in the injury have received little quantitative investigation, on account of the difficulty of distilling HCN from materials containing volatile substances that react with it, and the lack of a method with sufficient accuracy to recover relatively small amounts of HCN from the tissues.

The results reported in this paper are concerned only with the factors affecting the distillation and recovery of HCN from solutions

in the absence of tissues or in the presence of the foliage and fruit of *Citrus*. Methods are described for the handling of HCN in amounts as small as 10–15 mg. and for its distillation, recovery and determination from *Citrus* tissues. The experimental results indicate that *Citrus* leaves and fruits fix or alter a portion of the HCN during the fumigation period so that it cannot be recovered by distillation. The amounts that could be recovered were directly proportional to the amounts of fumigant used, and, in aeration tests with mature fumigated leaves, decreased in roughly inverse proportion to the length of time of aeration.

SEVERIN (H. H. P.). **Factors affecting Curly-top Infectivity of the Beet Leafhopper,** *Eutettix tenellus*.—*Hilgardia* **12** no. 8 pp. 497–530, 4 pls., 1 fig., 23 refs. Berkeley, Calif., 1939. [Recd. 1940.]

The following is based on the author's summary of investigations carried out in California during 1918–37 to determine what were the differences in the percentage of beet leafhoppers (*Eutettix tenellus*, Baker) able to transmit the curly-top virus in different localities and in different years, and to analyse the factors that may be involved: The percentages of infective adults of the spring generation were usually higher in the northern canyons of the San Joaquin valley than in Little Panoche Pass (in the middle San Joaquin valley), which is about 80 miles from the nearest beet fields, probably because many overwintering adults bred on beet infected with curly-top flew into them and spread the virus to susceptible plants. In Little Panoche Pass there appeared to be a correlation between the time of germination of the seeds of pasture vegetation, owing to autumn or early winter rainfall, and the proportion of infective leafhoppers of the spring generation; the percentages infective were 16–42 during 5 years after rainfall in November, and only 2–6 during 2 years after rainfall in December or January. There was a decrease in the percentage of beets infected during successive 30-day periods by adults kept on plants immune from curly-top and transferred singly to beets for 1 day; many of the infective leafhoppers apparently lost the capacity to produce infection. The juices from the immune plants did not appear to affect the period of infectivity of the leafhoppers and probably had no effect on the curly-top virus.

It has been demonstrated that 75 species of plants in 48 genera belonging to 18 families are naturally infected with this virus. It was found that 3 perennials growing on the uncultivated plains and foothills were naturally infected, but 16 perennials that serve as food-plants during dry autumns and early winters were not susceptible. The virus was repeatedly recovered from *Atriplex fruticulosa* and *Chenopodium ambrosioides* [*cf. R.A.E.*, A **23** 107], and natural infection of the perennial nightshade, *Solanum douglassi*, was found during severe outbreaks of the disease and may be associated with increased virulence of the virus. The virus was recovered from naturally infected fish geranium (*Pelargonium hortorum*) more often during spring than during autumn; this may be associated with a higher concentration of virus during the spring. *A. lentiformis* and *A. semibaccata* showed a high degree of resistance to the disease. The results of experiments on the recovery of the virus from weeds that serve as the most important plants for the breeding of *E. tenellus*,

obtained with single non-infective leafhoppers that fed on the infected weeds for periods of 2, 4 and 8 days, and with single adults that completed the nymphal stages on them, are given in tables. The most favourable virus reservoirs in order of decreasing importance were *A. bracteosa, A. argentea* subsp. *expansa, A. rosea* and Russian thistle (*Salsola kali* var. *tenuifolia*). The virus was recovered from all infected plants of the three species of *Atriplex*, but 18·8 per cent. of the Russian thistles were immune. It was recovered monthly by previously non-infective leafhoppers from the infected species of *Atriplex* during the season of the plants and transferred to beet. The transmission of the virus by adults reared on four species of infected weeds that attenuate the virus (*Chenopodium murale, C. album, Suaeda moquini* and *Rumex crispus*) is also shown. Many of the adults failed to recover the virus.

EBELING (W.). **The Rôle of Surface Tension and Contact Angle in the Performance of Spray Liquids.**—*Hilgardia* **12** no. 11 pp. 665–698, 9 figs., 22 refs. Berkeley, Calif., 1939. [Recd. 1940.]

The following is based on the author's summary: Although the static contact angle may not be a true index of the wetting and spreading properties of a liquid under the dynamic conditions that obtain during the actual spraying operation, it indicates the spreading and penetrating qualities of the liquid after it has been deposited on the plant surface. An accurate and practicable method of measuring the contact angle is described; it involves the projection of a drop of liquid resting on a perfectly horizontal substratum and the tracing of the projected image.

The outlines of drops 5 mm. in diameter were elliptical, but were practically circular for liquids with contact angles less than 65°. Smaller drops retain a spherical shape at even higher contact angles. Methods of calculating the contact angle are given, and it is shown statistically that 5 measurements of this for a given liquid are sufficient to establish a highly significant mean, and that a difference as low as 3° 22′ can be reliably determined. Size of drop had no significant effect on contact angle. The nature of the substratum had a great influence on the contact angle between liquid and solid, which was much greater between oil and leaf wax than between oil and the wax of scale insects. Various solutes were tested with reference to their effect in reducing the contact angle of water and oil on various solids. The relative spreading ability of solutions varied on different substrata. It is shown that a reduction of the surface tension and consequently of the contact angle would decrease the rate of penetration of aqueous solutions into porous solids such as bark, on which they have a very low contact angle, and increase their rate of penetration through the waxy threads exuded by insects, or under their bodies and into their spiracles, reducing the great difference in the rate of penetration of the solutions into insects on porous bark and into the plant.

The addition of some of the more effective wetting agents may reduce the surface tension of water enough for toxic aqueous solutions to penetrate under the body of the red scale, *Aonidiella aurantii*, Mask., and cause the death of the insect. Increased effectiveness and concentration of the spreading agent resulted in greater insecticidal efficiency of a given toxic agent.

Amos (J. M.) & Stearns (L. A.). **Bionomics and Control of the Oriental Fruit Moth** (*Grapholitha molesta*, **Busck**).—*Bull. Delaware agric. Exp. Sta.* no. 220 pp. 25–26. Newark, Del., 1939. [Recd. 1940.]

In each year from 1931 to 1938, inclusive, the percentage parasitism of larvae of the first three generations of *Cydia* (*Grapholitha*) *molesta*, Busck, infesting peach twigs in three counties in Delaware, and the percentage of the parasites represented by *Macrocentrus* (chiefly *M. ancylivorus*, Rohw.) have been determined by periodical collections from the same orchards. The figures for each year are shown in a table. On an average for the whole period, 59 per cent. of the larvae were parasitised and 92 per cent. of the parasites were *Macrocentrus*. In 1938, the corresponding percentages were 73 and 97, which were the highest recorded. It is evident that so long as such a scale of parasitism exists, *C. molesta* will not be a serious pest of peaches. In 1938, pupal parasitism was also investigated, cocoons being collected from trees at different times throughout the summer. The percentage parasitised was 84·6 per cent.; and miscellaneous parasites, *Macrocentrus* and hyperparasites, probably of the latter, accounted for 7·6, 44·7 and 47·7 per cent., respectively, of it. The principal hyperparasite was a species of *Eupelmus*.

Manns (T. F.). **Yellows and Little Peach; the Cause, Means of Dissemination, and Control.**—*Bull. Delaware agric. Exp. Sta.* no. 220 pp. 33–34. Newark, Del., 1939. [Recd. 1940.]

It has been shown that certain plums constitute a source of the virus or viruses of peach yellows and little peach in Delaware [*R.A.E.*, A **22** 298; **23** 443] and that the Jassid, *Macropsis trimaculata*, Fitch, is a vector [*cf.* also **26** 385], but an experiment in the spring of 1936 indicated that *Philaenus leucophthalmus*, L., is a more efficient vector of peach yellows. Examples of this Cercopid that had fed on trees infected with virulent yellows were transferred to 4 large peach trees in an insect-proof cage. All these trees became infected, while control trees remained healthy. At the same period, numerous individuals of *P. leucophthalmus*, but none of *M. trimaculata*, were taken from infected peach trees; notes are given on variations of colour and body markings in the specimens obtained.

White (R. T.). **The Relation of Ants to the Japanese Beetle and its established Parasites.**—*J. N.Y. ent. Soc.* **48** no. 1 pp. 85–99. Lancaster, Pa., 1940.

The following is substantially the author's summary: To obtain information on the part played by ants in the destruction of *Popillia japonica*, Newm., and its parasites, observations were made of the ants occurring near Moorestown (New Jersey), and 23 species, representing 11 genera, found to be the most common, were studied in the insectary.

Ants were observed attacking living larvae as well as adult beetles in the field, but comparative data from field surveys in areas infested with ants showed very little difference in the larval population. The results of numerous insectary experiments testing any possible relationship existing between ants and *P. japonica* indicated that

little, if any, harm was caused by the 23 species used, either to the egg or to any subsequent stage. *Formica fusca* var. *subsericea*, Say, was observed overpowering adults of *Tiphia vernalis*, Rohw., and *T. popilliavora*, Rohw., in the field. Experiments dealing with the various ants and *Tiphia* cocoons in the soil showed that only one species, *Solenopsis molesta*, Say, damaged the cocoons consistently. Cocoons riddled by the tiny workers of this ant were found in the field as well as in the insectary. Single records are given of the finding within colonies of *F. fusca* var. *subsericea* of a beetle containing an egg of *Centeter cinerea*, Aldr., and of the remains of another, which belonged to the genus *Lachnosterna* (*Phyllophaga*), containing a fly puparium.

Strong (L. A.). **Report of the Chief of the Bureau of Entomology and Plant Quarantine, 19**[38–]**39.**—117 pp. Washington, D.C., U.S. Dep. Agric., 1940.

An account is given of work on insect pests and their control in the United States during the year ending June 1939, some of which has already been noticed.

Although 144,000 adults of the codling moth [*Cydia pomonella*, L.] were caught in an orchard in Washington by means of bait-traps, and liberations of marked moths indicated that the population was being reduced by 50 per cent., there were only slighly fewer injured apples at harvest time than in neighbouring unbaited orchards, from which adults had probably immigrated. In experiments with marked adults in Indiana, heavy migration from an unbaited to a baited area took place during the summer. Thiodiphenylamine (phenothiazine) applied throughout the season or as a final spray after a light programme of arsenical applications continued to control the apple maggot [*Rhagoletis pomonella*, Walsh] in the Hudson River Valley. A high degree of parasitism among twig-infesting larvae of the oriental fruit moth [*Cydia molesta*, Busck] is an important factor in reducing infestation on the fruit of mid-season varieties of peach, and experiments in New Jersey showed that early parasitism can be substantially increased by the liberation of comparatively small numbers of parasites. The degree of parasitism, especially of the first generation, was the highest yet recorded, and parasitism by *Macrocentrus ancylivorus*, Rohw., is still increasing. Parasitism increased more rapidly after liberations of *Angitia* (*Inareolata*) *molestae*, Uch., than after those of *Microdus* (*Bassus*) *diversus*, Mues.

The hickory shuckworm [*Enarmonia caryana*, Fitch] was found to have in part a two-year life-cycle on pecan in Georgia ; 15 per cent. of the larvae that entered hibernation in 1936 did not complete their development until 1938. The survival of the species is thus ensured in years when pecan nuts are not available. Before the pecan nuts are formed, the insect breeds in galls made by *Phylloxera*, in which development proceeds more rapidly than in the nuts. In Florida, infestation by the pecan nut casebearer [*Acrobasis caryae*, Grote] was reduced by 69 per cent. after a single application of a commercial nicotine-bentonite mixture with summer oil emulsion, and by 81 per cent. after a second application. Field applications of tar distillates at concentrations of 3 and 6·66 per cent. during the dormant period reduced populations of the first generation by 37 and 93 per cent., respectively. In Texas, pecan buds and shoots were attacked before the nuts, and should therefore be sprayed as well. Severe infestation occasionally

follows years in which the crop has failed, and the successful rearing of a number of individuals from egg to adult on shoots and buds in Florida provides a probable explanation. The distribution of *Cydia* (*Melissopus*) *latiferreana*, Wlsm., an important pest of filberts [*Corylus*], was found to extend from the Canadian border of Washington to southern California. In the north-west, it has been found only on filbert, hazel and oak, but in southern California it was reared from the fruit of Catalina cherry [*Prunus lyonii*] and from oak galls.

Two strains of the California red scale [*Aonidiella aurantii*, Mask.] on *Citrus*, one resistant and the other non-resistant to fumigation with hydrocyanic gas [*cf. R.A.E.*, A **22** 99], were equally susceptible to methyl bromide, the stages that are most resistant to the former being least resistant to the latter. Methyl bromide does not appear to induce protective stupefaction [**27** 343], and favourable results were given in preliminary experiments by mixtures of the two fumigants. In field tests against this Coccid in California, the addition of cubé extract or nicotine to mineral-oil emulsions increased their effectiveness to a marked extent, particularly against scales on wood, where oil alone is less effective. A mixture of trichlorethylene and dibutyl phthalate was the most satisfactory of several materials tested as mutual solvents between cubé resins and oil. *Citrus* in Florida was protected from re-infestation by the rust mite [*Phyllocoptruta oleivorus*, Ashm.] for a longer time by 2,000-mesh sulphur dust applied at the rate of ½ lb. per tree than by standard 325-mesh sulphur dusts used at double the rate, and for considerably longer by a spray containing 5 lb. 2,000-mesh wettable sulphur per 100 U.S. gals., with or without adhesives, than by one containing 5 or 10 lb. 325-mesh wettable sulphur ; no harmful effects were observed on the trees.

The standard bait containing geraniol and clove eugenol became less attractive to adults of the Japanese beetle [*Popillia japonica*, Newm.] after a week's exposure ; the eugenol appears to retard the decrease in attractiveness of the geraniol rather than to increase its initial attractiveness. The collection and liberation of the parasites, *Tiphia popilliavora*, Rohw., and *T. vernalis*, Rohw., was continued during the year. Efforts to establish the Korean strain of the former [**26** 324 ; **27** 377] were continued, as it attacks third-instar larvae in the autumn and would supplement control by *T. vernalis*, which attacks larvae of the same stage in spring. A colony of the Tachinid, *Centeter cinerea*, Aldr., was liberated in Washington, D.C., to determine its synchronisation with *P. japonica* in a more southerly region than those in which it has previously been released. Larvae of *P. japonica* are apparently attacked by milky diseases [**26** 324 ; **27** 377] rather generally throughout much of the area originally infested [**28** 416], except at heavily infested points on the outer fringe and in New England. In field plots that were first infected artificially in 1936, the incidence of the disease was very high and most of the larvae were destroyed. Artificial media were not successful for the propagation of the causal organisms, and the bodies of larvae are therefore used for this purpose. Spores of both A and B types of the disease were as effective in puncture inoculations after storage for 41 months in films of dried blood on glass slides in wooden slide boxes as fresh spores. A mixture of the pulverised bodies of diseased larvae and talc or precipitated chalk, passed through a 100-mesh sieve, can be stored until required, and applied in water as a spray or mixed with soil and broadcast.

The prevalence of over-mature trees in stands of commercial pine in north-eastern California is thought to provide breeding grounds for endemic infestations of the western pine beetle, *Dendroctonus* [*brevicomis*, Lec.], which at times become epidemic. As the result of previous investigations, experiments are being conducted to determine the value of felling highly susceptible but uninfested living trees instead of trees already infested, in order to avoid blue-staining in the timber and to remove trees in which populations of *Dendroctonus* can breed up. The black hills beetle [*D. ponderosae*, Hopk.] is the most destructive pest of forest trees in the central Rocky Mountain region, where, since 1935, it has caused heavy losses to lodgepole pine [*Pinus contorta*], limber pine [*P. flexilis*] and ponderosa pine [*P. ponderosa*]. In some areas, all the trees over 18 ins. in diameter at breast-height, and more than 80 per cent. of those over 6 ins., have been destroyed. Infestation was reduced to an endemic condition in most areas where control measures were carried out. Observations during 1938 established that the hemlock borer [*Melanophila fulvoguttata*, Harr.] is not a primary pest of hemlock [*Tsuga*] in central Wisconsin, since it can successfully attack and complete its development only in weak or dying trees [*cf.* **27** 378]. Fewer trees were killed by it in 1938, probably as a result of more abundant rainfall and favourable growing conditions. More than three times as many adults of *Scolytus multistriatus*, Marsh., were collected on felled elm trees in New Jersey in 1938 as in 1937, when the supply of available breeding material was appreciably smaller, whereas the number of adults of *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., was more than halved ; a higher percentage of both species carried *Ophiostoma* (*Ceratostomella*) *ulmi*, the fungus causing Dutch elm disease. Adults of *H. rufipes* are of less importance as carriers, partly because, although they frequently bore through the bark of living elms and reach the xylem, this is done chiefly in early spring, before the spring vessels are mature and when there is less chance of infection. Aqueous solutions of sodium arsenite, copper sulphate [*cf.* **28** 336], ammonium bifluoride, copper nitrate and copper chloride are toxic to elm trees, and effectively controlled both bark-beetles when injected into trees in leaf. Solutions of copper sulphate were used at the rate of 60 gm. (based on the dry weight of the salt) per inch diameter on trees up to 12 ins. in diameter at breast height. In preliminary studies, a combined spray of lead arsenate and lime-sulphur applied to elms in leaf prevented *S. multistriatus* from feeding in the crotches. Sprays containing fuel oil and either orthodichlorobenzene or naphthalene were to some extent effective in destroying bark-beetle larvae in elm logs.

In the late summer of 1938, a migration of the lesser migratory grasshopper [*Melanoplus mexicanus*, Sauss.] on an unprecedented scale took place from western South Dakota into western North Dakota and eastern Montana [**28** 369], and eggs were laid in very large numbers not only on cultivated and recently reverted lands, but also on open range lands. The severe infestation by young hoppers that ensued in the following June was brought under control by prompt distribution of bait from aeroplanes, and such migrations as took place from the heavily infested areas were mostly to the north-west, and not to crops on neighbouring recently freed districts.

Although *Hypera brunneipennis*, Boh., occurs on lucerne in both California and Arizona [**28** 120, 187], it prefers sweet clovers [*Melilotus*] and fenugreek [*Trigonella foenum-graecum*]. There is little danger

of its dispersal in lucerne seed from the infested area, since all adults that passed into the threshing machine were killed. *Bruchus brachialis*, Fhs., which was first recorded from vetch seed in Oregon in 1938, was observed in 8 counties in Oregon and 4 in southern Washington. On leaving the vetch pods in late June or early August, the adults immediately seek hibernation quarters, the nature of which is unknown. In preliminary tests, mostly in North Carolina, some commercially important varieties of vetch were found to be immune or strongly resistant to attack.

As a result of the campaign against *Pantomorus leucoloma*, Boh., and *P. peregrinus*, Buch. [*cf.* **27** 275; **28** 470], the populations appear to be considerably reduced, though to a less degree in fields bearing leguminous crops or where cryolite was substituted for calcium arsenate dust to avoid injury to the crops. *P. leucoloma* is generally distributed throughout Argentina and Uruguay, where, however, it is not of economic importance, but does not extend into the subtropical regions of southern Brazil. No natural enemies were found.

In studies on the control of the tomato fruitworm [*Heliothis armigera*, Hb.] in California, Utah and southern Indiana, applications of dust composed of 70 parts (by weight) cryolite and 30 parts talc [*cf.* **27** 379] gave 30–90 per cent. control (based on the percentages of damaged fruits), and resulted in the best yield of uninjured fruit. Natural cryolite containing approximately 90 per cent. sodium fluoaluminate and two synthetic cryolites containing approximately 98 and 83 per cent., respectively, were used. Calcium arsenate, which was as toxic to quarter-grown larvae in the laboratory as cryolite, gave 30–64 per cent. control. Eggs are deposited principally on both surfaces of leaves at the edge of the plants, and both sides of the leaves should therefore be covered. Three applications of a bait containing 1 lb. cryolite, 10 lb. bran and 1 U.S. quart maize oil scattered evenly over the whole plant at fortnightly intervals was almost as effective as the cryolite dust. Sprays of cryolite (8 lb. per 100 U.S. gals. water) with the addition of an adhesive or wetting agent were fairly effective, and indications were obtained that a dust containing 40 per cent. thiodiphenylamine might prove satisfactory if a suitable adhesive were found.

In general, the tomato pinworm [*Keiferia lycopersicella*, Busck] caused less damage to tomatos in southern California during 1938, except where successive plantings were made during the frost-free period. This is attributed largely to the cleaning up and destruction of crop remains after harvest. Although 3 or 4 well-timed applications of dusts or sprays of cryolite or cuprous cyanide give adequate control (85–90 per cent.) under normal conditions, 1 or 2 more applications are required during the picking season when weather conditions favour the building up of large populations. In southern California, temperatures below freezing point greatly increase the rate of mortality during winter, but the effect of favourable winter conditions on adult survival and the rate of oviposition may be counteracted by cool wet weather during spring and early summer. Two undescribed species of parasites, and two not hitherto recorded from southern California, have acted as checks in recent years.

In view of the development of large-scale dusting equipment for the control of the pea Bruchid [*Bruchus pisorum*, L.] the amount of mechanical damage to crops resulting from its use was studied in Washington. The injury caused by dusting equipment with a 30 ft.

swath reduced the yield by about 5 per cent. when drawn by caterpillar tractors with 8 in. treads, and by only 2½ per cent. or less when horse-drawn. Large units are believed to cause less injury than smaller ones, as relatively fewer trips are made, and in general the mechanical damage due to dusting equipment is considered to be unimportant compared with the control obtained. Dusts containing 1 per cent. rotenone were more effective than those containing 0·75 and 0·5 per cent., but the difference in toxicity between the first and second was less than that between the second and third, especially in spring. A cubé dust gave lower mortalities, particularly at higher dosages, with diatomaceous earth as a carrier than with talc, but near the median lethal dose the difference was not significant. The addition of small quantities of ground-nut oil, sodium oleyl sulphate or water did not increase the effectiveness of a cubé dust with talc as carrier, but the toxicity of one containing 0·5 per cent. rotenone was increased to a marked extent by the addition of 0·225 per cent. total pyrethrins. A dust mixture containing 0·005 per cent. sulphur nitride was ineffective. Dense growths of pine are the preferred hibernation quarters of this Bruchid, but it can also successfully overwinter among grass, grain, weeds, stubble, and débris of various kinds. Studies in Oregon established that flight activity almost ceases when the daily maximum temperature is no higher than 66–74°F., and reaches a peak only at temperatures of 68–74°F. or higher; daily activity reaches a peak in the late morning and early afternoon, and its extent is directly correlated with the daily maximum temperature. A higher range of temperature was needed to induce flight in spring and summer than in autumn.

In further tests against the gladiolus thrips [*Taeniothrips simplex*, Morison] with tartar emetic [**26** 552], sprays containing 2, 3 or 4 lb. tartar emetic and 8 or 16 lb. brown sugar per 100 U.S. gals. differed little in effectiveness, but the residual effect of the lowest concentration was less and injury was therefore greater during the late flowering season. These sprays did not injure the foliage, whereas one containing 2 lb. Paris green and 64 lb. brown sugar per 100 U.S. gals. water caused moderate to severe damage, according to the variety on which it was used. Sprays containing derris and ground-nut oil were ineffective, injured the plants by stunting and retarding their growth and left an oily residue on which dust collected, causing the leaves to turn yellow. No appreciable control was given by a spray containing tartar emetic alone at the concentration of 4 lb. per 100 U.S. gals. water; the inclusion of a sweet substance is therefore essential. In the spring, the corms are immersed in a solution of mercury bichloride (corrosive sublimate) to destroy any thrips present on them, and tests showed that corms enclosed in burlap bags and soaked in a 0·1 per cent. solution for 17 hours at temperatures of 60 and 70°F. absorbed 37 and 69 per cent., respectively, of the chemical. Attempts to recharge the solution after it had been used once by the addition of approximately half the original weight of mercury bichloride resulted in the production of unreliable solutions.

In Arizona, work was continued on the Pentatomids and Capsids that attack cotton [**27** 416]. Short-staple cotton was again the most severely injured, 31·5 per cent. of the bolls being punctured by Pentatomids, whereas the percentage of injured bolls of long-staple cotton was 14·6. Applications of sulphur dust, and mixtures of Paris green and sulphur (1 : 12) and calcium arsenate and sulphur (1 : 4)

gave variable results in the three districts in which they were tested ; in general increases in yield were profitable, though smaller than those obtained in 1937 [*cf.* **27** 381].

In Texas, applications of dusts of calcium arsenate or barium fluosilicate against the bollworm [*Heliothis armigera*] increased the yield of seed-cotton by 41 per cent. Cryolites containing 20 or 85 per cent. sodium fluoaluminate gave an increase of 23 per cent., but when cryolite in which the sodium fluoaluminate content was 90 per cent. and one with coarse particles in which it was 78 per cent. were used, the percentage increases in yield were only 12·5 and 9·5, respectively. Three applications of each insecticide were made at intervals of 5–7 days, beginning on 7th August, when the numbers of eggs per 100 terminal buds averaged 28. In tests extending over 10 years, a schedule comprising applications of calcium arsenate at the rate of 8–10 lb. per acre at intervals of 5 days during the oviposition period proved the most effective and economical.

The value of the early destruction of cotton stalks [**27** 381] was demonstrated in Texas, where the percentage of larvae of the pink bollworm [*Platyedra gossypiella*, Saund.] that left the green bolls during the first and last fortnights in September and the first fortnight in October was 0·33, 7 and 20, respectively ; nearly all those that become full-grown later in the season hibernate. When larvae were kept under optimum moisture conditions during winter or when moisture was increased by irrigation in spring, pupation began earlier and adult emergence was completed sooner than when soil moisture was low ; the time and rate of emergence were also influenced by temperature. Survival was higher in heavy adobe soils than in sandy ones, and among cocoons on the surface than among those buried 2–6 ins. deep. Bolls of *Thurberia thespesioides* growing in close proximity to infested cotton were readily attacked, and larvae overwintering in *Thurberia* bolls successfully completed their development in the insectary. Work on biological control of *Platyedra* was continued in Texas and Mexico, where liberations of the Hawaiian strain of *Microbracon mellitor*, Say, *M. nigrorufum*, Ashm. [**27** 381], and *Chelonus blackburni*, Cam., were made. The last two species were recovered, but it is not known if they are established. A light outbreak of *P. gossypiella* was discovered in the Coastal Bend section of Texas, and infestation occurred in the Salt River Valley, Arizona, for the first time for several years. Infestation was heavier than in recent years in the lower Rio Grande Valley.

Parasites imported into the United States from Europe during the year were : *Trichacis remulus*, Wlk., against *Mayetiola destructor*, Say ; *Triaspis thoracicus*, Curt., and a new larval parasite of the genus *Tetrastichus* against *Bruchus brachialis* ; *Phaeogenes nigridens*, Wesm., against *Pyrausta nubilalis*, Hb. ; *Phanerotoma planifrons*, Nees, *Microbracon pectoralis*, Wesm., *M. piger*, Wesm., and *Chelonus* sp. against the lima bean pod borer [*Etiella zinckenella*, Treitschke] ; *Meigenia mutabilis*, Fall. (*floralis*, Fall.) against the asparagus beetle [*Crioceris asparagi*, L.] ; and *Rhacodineura pallipes*, Fall. (*antiqua* Mg.) against the European earwig [*Forficula auricularia*, L.]. *Phaeogenes haeussleri*, Uch., was imported from Japan against *Cydia molesta*. Consignments of one species of *Microplectron* and two of *Exenterus* were received from Canada for liberation against the European spruce sawfly [*Gilpinia polytoma*, Htg.], and a rearing stock of the São Paulo

strain of *Metagonistylum minense*, Tns., a promising parasite of the sugar-cane borer [*Diatraea saccharalis*, F.], was obtained from Porto Rico. A list is given of parasites and predators shipped to other countries.

Chemical investigations on insecticides and the removal of spray residues are briefly reviewed.

BONDE (R.). **The Role of Insects in the Dissemination of Potato Blackleg and Seed-Piece Decay.**—*J. agric. Res.* **59** no. 12 pp. 889–917, 9 figs., 17 refs. Washington, D.C., 1939. [Recd. 1940.]

An account is given of investigations in Maine and South Carolina to determine the part played by certain insects in the dissemination of the bacteria causing blackleg and seed-piece decay in potato, the factors that influence the attack by insects, and the consequent development of these diseases. The seed corn maggot, *Hylemyia cilicrura*, Rond., is widely distributed throughout Europe and the United States. In north-eastern Maine, the adults are prevalent in spring during the potato planting season. In 1932, adults from the overwintering puparia emerged from the soil in great numbers on 17th–19th May, following several days of warm weather. The flies are most abundant from mid-May to mid-June, are most active after warm rain, and are attracted to moist, freshly turned soil. The eggs are laid in the soil and hatch in a few days. The larvae feed on vegetable matter and become full-fed in 7–12 days, when they leave the vegetable substratum, enter the soil and pupate. In 1932, full-grown maggots ready to pupate were observed on 6th June in decayed potato seed-pieces ; and by 21st June, adults from the overwintering puparia had almost disappeared and those of the new generation were emerging. These also disappeared within a week or two. All stages of the insect occur to some extent throughout the summer, and although the adults diminish in numbers during July and August, they become more numerous again in late August and September. Potato tubers affected with late blight rot followed by bacterial organisms serve as a favourable host for *H. cilicrura* in late summer. Puparia have occurred in late September and early October and these apparently overwinter. In experiments, adults were not more attracted by rotted tubers than by healthy ones, but many more visited the surfaces of freshly cut than uncut tubers. They were also attracted to fish and cottonseed meal used as bait.

The seed potato maggot, *Hylemyia trichodactyla*, Rond., also infests seed potatoes [*cf. R.A.E.*, **10** 193] and was reared from rotted seed-pieces from the field. Adults were caught by sweeping with a net and by bait traps in potato fields, and counts suggested that *H. trichodactyla* is more prevalent in north-eastern Maine than *H. cilicrura*. The life-histories of the two Anthomyiids are essentially the same. Soft-rot and other pathogenic bacteria were isolated from the surface of eggs and from within puparia and adults of *H. cilicrura* [*cf.* **14** 269] in Maine and South Carolina, while bacteria causing blackleg were isolated from overwintered puparia from potato fields in Maine. The organism causing soft rot apparently assisted the development of *H. cilicrura*, but was less important in this respect than others. In experiments in which adults of either *H. cilicrura* or *H. trichodactyla* were enclosed with freshly cut tubers in sterilised soil, bacterial decay

developed in those that became infested by larvae, but the adults were unable to transmit the bacteria by contact [*cf.* **18** 219]. Investigations indicated that seed-pieces free from decay are not attacked; the larvae are attracted to bacterial lesions on seed-pieces or to pieces injured by fertiliser burning or by desiccation, but not to lesions caused by fungi and free from bacteria. Shallow surface lesions are formed when unsuberised pieces are planted in moist warm soil in South Carolina. The young contaminated larvae of *H. cilicrura* migrate and enter the seed-pieces through these lesions, aggravating the decay by their burrowing, and the seed-pieces are completely destroyed if the moisture content of the soil is relatively high. Freshly cut potato seed may be safely planted in north-eastern Maine without danger of injury by maggots, but freshly cut pieces injured by excessive drying often develop a softened condition on their cut surfaces and bacterial contamination may be established there. Such diseased areas are liable to attack by larvae of both flies. Other insects that are commonly associated with decaying potato parts in the field and in storage bins in Maine but that do not assist in bringing about these conditions [*cf.* **18** 220] include *Musca domestica*, L., *Trichocera* sp., *Drosophila funebris*, F., and *D. buscki*, Coq., *Sciara tridentata*, Rübs., *Dermestes lardarius*, L., and *Hypnus* (*Cryptohypnus*) *abbreviatus*, Say. However, a Staphylinid found associated with decaying seed-pieces and plants affected with blackleg may assist in the dissemination and destruction of potato pieces in this State.

Reid (W. J.), jr., Wright (R. C.) & Peacock (W. M.). **Prevention of Damage by the Seed-corn Maggot to Potato Seed Pieces.**—*Tech. Bull. U.S. Dep. Agric.* no. 719, 37 pp., 4 figs., 30 refs. Washington, D.C., 1940.

The following is based on the authors' summary: Larvae of the seed-corn maggot, *Hylemyia cilicrura*, Rond., which is widely distributed throughout North America, cause severe damage to newly planted potato seed-pieces [see preceding abstract], particularly those of the early crop in sections of the South Atlantic coastal plain. Injury was found to be most prevalent in soils rich in decaying vegetation, particularly after the ploughing under of the remains of such crops as cabbage, spinach and beans. Preliminary investigations indicated that no chemical treatment was effective in preventing damage by this Anthomyiid; coating the seed-pieces with finely ground sulphur was promising in early studies, but did not give a significant reduction of infestation in more intensive tests. The most important observation was that seed-pieces with well-healed cut surfaces were notably free from injury. Suberisation, the process of which is briefly described, takes place in the soil under favourable conditions, but these are not often present when the early crop is planted. Intensive tests were made during five seasons in three localities to determine the value of suberisation in advance of planting. Seed-pieces that had been cut and kept for 6–28 days at known temperature and humidity were compared in field plots with seed of the same stock planted when freshly cut (the usual practice). The results are based on the comparative infestation by *H. cilicrura* of 25 seed-pieces of each treatment taken at random from each plot each week during the period of insect activity, and upon the yield of U.S. No. 1 tubers on the

entire field plot. Statistical analysis of the data of the five seasons indicated that the odds are above 9,999 : 1 that the seed-pieces suberised in advance of planting are less infested than freshly cut pieces. Seed suberised under partly controlled temperatures as well as that suberised at existing temperatures was significantly less infested than that planted while freshly cut, the mean differences in infestation being 21·3 and 17·9 per cent., respectively. Considering both types of storage together, the reduction in maggot infestation with suberised seed-pieces was 19·3 per cent. in the tests in which infestation developed and 15·7 per cent. when all experiments are considered, regardless of whether the insect was present or not. These infestation figures are based on the total number of seed-pieces that either contained *H. cilicrura* or showed evidence of larval feeding, and represent the average and not the peak of infestation. By considering all the experiments as a whole, a highly significant mean difference of 7 bushels per acre in yield was found to exist in favour of suberised seed-pieces, while in the case of U.S.A. No. 1 tubers the difference was as much as 10·7 bushels per acre. Suberisation in advance of planting has proved an excellent means of preventing maggot injury to potato seed-pieces ; a method of obtaining satisfactory suberisation is described.

Hunt (G. M.) & Snyder (T. E.). **An international Termite Exposure Test.—Tenth Progress Report.**—*Proc. Amer. Wood Pres. Ass.* **35** pp. 350–361. Chicago, 1939. **Eleventh Progress Report.**—*Op. cit.* **36** preprint 14 pp. Chicago, 1940.

In these two annual reports of the progress of a large-scale experiment on the effectiveness of various chemicals in preserving specimens of wood from attack by termites [*cf. R.A.E.*, A **27** 180], data are given in tables on the condition of the original specimens in Australia, the Panama Canal Zone, Hawaii and South Africa after 10 and 11 years' exposure, and also of subsequent series of specimens installed in the Canal Zone in 1931 and 1933, the latter in order to test a proprietary creosote preservative. In September 1938, a further set of test specimens was installed in the Canal Zone for the purpose of studying the effectiveness of different absorptions of sodium pentachlorphenate and sodium tetrachlorphenate. The technique adopted is described in the eleventh report, and the results of one year's exposure are given. Both reports have a concluding paragraph substantially identical with that noticed from the preceding one [*loc. cit.*].

Zimmerman (F. R.). **Grasshopper poisoning Campaign.**—*Wisconsin Conservation Bull.* **4** no. 11 pp. 13–14. Madison, Wis., 1940.

At the close of 1938, the Wisconsin Conservation Department sent out questionnaires to county agents, to report on losses of wildlife or domestic stock resulting from the grasshopper poisoning campaign, during which 13,937 tons of poison bait were distributed to over 41,000 farms. Of the bait used, 99 per cent. consisted of sawdust, whey, sodium arsenite and water, spread at the rate of 20 lb. per acre. The only mortalities reported were those of one bird and five cows, and the poisoning of the latter resulted from gross carelessness in applying the bait.

Bondar (G.). **Insetos nocivos e molestias do coqueiro** (*Cocos nucifera*) **no Brasil.** [Insect Pests and Diseases of the Coconut in Brazil.]—*Bol. Inst. cent. Fom. econ. Bahia* no. 8, 160 pp., 39 pls., 4 pp. refs. Bahia, 1940.

This book on the pests and diseases of coconut (*Cocos nucifera*) in Brazil is a revision of an earlier work by the author [*R.A.E.*, A **11** 120]. The section on insects (pp. 4–131) has been considerably expanded, the number of species dealt with is increased and some changes are accepted in nomenclature, especially that of the Aleurodids. The information given includes notes on the morphology of the various stages, the life-history, economic importance and control. The only species dealt with in detail are *Rhynchophorus palmarum*, L. [*cf.* **27** 22] and *Homalinotus coriaceus*, Gylh.

A brief section (pp. 141–144) comprises formulae and directions for preparing some common insecticides and fungicides not previously mentioned in the text.

Dicker (G. H. L.). **The Biology of the Rubus Aphides.**—*J. Pomol.* **18** no. 1 pp. 1–33, 1 pl., 2 figs., 23 refs. London, 1940.

The results are given of investigations on the biology of the Aphids that attack *Rubus* at East Malling, Kent. Notes are given on their distribution and the appearance of the eggs of the four commoner species. *Macrosiphum rubiellum*, Theo., breeds sparingly on many cultivated varieties of *Rubus*, but is found in great numbers only on plants of direct blackberry origin ; it is the only common Aphid on *Rubus* that migrates to a summer food-plant. The eggs are laid singly on the current year's growth, usually along the main cane of the lateral shoots. Under favourable conditions in the laboratory, the numbers of eggs averaged nearly 11 per female, but the average would probably be lower in the field. In 1937 and 1938, young Aphids were first observed in the field early in February, when the lateral shoots had begun growth, and they continued to hatch for about a month. They migrated to the nearest bud, and settled on the lower surface of an unfolding leaf or round the bursting bud. As the lateral shoots grow and the basal leaves mature, they move towards the growing tips. Reproduction is rapid, and by the end of April the upper 6 inches of the shoots and the lower surfaces of the leaves are often completely covered with Aphids. The population on 10 lateral shoots from each of 48 cultivated blackberry plants rose from 1 on 11th February to 5,711 on 11th April, after which the plants were sprayed. The survivors multiplied rapidly, and a month later the infestation almost equalled that before spraying. Severe leaf-curl is caused by the feeding of such large populations. Alate forms were produced in the third generation. In 1937, they were first noticed on 10th May and had all left cultivated blackberry by the end of the first week in June. The alatae develop about 10 days later on wild blackberry and have usually left it by 21st June. Alatae kept on blackberry failed to reproduce.

Observations in 1938 showed that the summer food-plant is *Poa annua*. Alate viviparae returned from this grass to blackberry between early October and mid-December and gave rise to apterous oviparous females. The winged males, which are produced on *P. annua*, were present on *Rubus* throughout November and sometimes in December, but were far less numerous than the oviparae. The latter were most

abundant in both seasons about five weeks after the arrival of the first winged migrants, and the last were observed in February and December 1938, respectively. Five weeks is probably the average length of life in the field, though it was about 6 weeks in the laboratory. A list is given of the winter food-plants of *M. rubiellum*, which consist almost wholly of blackberries and hybrids with a blackberry parent, but also include cultivated strawberry, the importance of which in this connection is unknown. A few oviparae laid eggs on strawberry in 1937, young Aphids developed in the following spring, and breeding continued until migration ensued. Alate viviparae observed on raspberry and raspberry × dewberry hybrids in autumn gave rise to oviparae, but no Aphids were present in the spring, either because growth begins too late, or because these plants are unattractive.

M. rubifolium, Theo., is much less common than *M. rubiellum*; it seldom occurs in large numbers on cultivated varieties of *Rubus*, and in May-June is more numerous on wild blackberry. While the young canes are growing, it is found almost entirely round the tips of the shoots. In the laboratory, the eggs hatched from the second week in March to early April, but young Aphids were not observed in the field before the end of April. Alate viviparous females appear in the second half of May and are present on blackberry until mid-July; no alternate summer food-plant has been recorded, and in the laboratory the alatae deposited their young on blackberry. Infestation of blackberry spreads rapidly in May and decreases in the second half of July, after which very small numbers are present. Oviparous females occurred in small numbers in early October, and occasional winged males were found at the end of October and during the first half of November. No oviparae were present after the end of December. The eggs were laid singly on the cane or the lower surface of a leaf. From May onwards, two distinct forms of the Aphid were observed in the field in approximately equal numbers, of which one was green and the other mainly red or purple. In August 1937, red and green forms from a mixed colony were segregated and kept in the laboratory under similar conditions; the green form gave rise to sexuales in October, and viviparous reproduction ceased, but the red form continued to breed viviparously throughout the winter, and the colony was still active in April, no sexual forms having developed. A list is given of food-plants of *M. rubifolium*, all of which are blackberries or hybrids with a blackberry parent. Attempts to establish colonies on raspberry were unsuccessful.

The eggs of *Amphorophora rubi*, Kalt., are laid singly on the canes or lower surface of the leaves of blackberry and raspberry. Oviposition begins about mid-October, and the oviparous females persist in small numbers until mid-December. Up to 30 per cent. of the eggs are laid on the leaves, and probably do not survive on raspberry, which sheds its leaves in December. The eggs hatched during the first fortnight of March, about a week earlier on cultivated blackberry than on raspberry. The newly hatched fundatrices migrated to the nearest growing bud, sometimes feeding for a time on old leaves on blackberry. When the leaves open, the Aphids live on the lower surfaces. Alatae develop in the third generation of the year and are present during June and most of July. They fly to other raspberry canes, particularly younger ones, and to many other forms of *Rubus*. Only apterous viviparae are present from the end of July until the sexual forms appear early in October. The winged males are not common and

die out by mid-November. Fluctuations in the population observed during the season, and possible reasons for them, are discussed in some detail. Investigations in Washington [*R.A.E.*, A **25** 623; **27** 280] have shown that *A. rubi* will not breed on Lloyd George raspberries, which it infests throughout the year in England. As the variety is presumably identical in both countries, it is concluded that two strains of the Aphid are involved. Its food-plants are listed and discussed; they are numerous in the genus *Rubus*, but reasons are given for doubting statements that they include plants of other genera.

Of the two species of *Aphis* that have been observed on *Rubus* at East Malling of recent years, much the commoner is *A. idaei*, Van der Goot, which attacks raspberry and hybrids with a raspberry parent. Blackberry is infested only accidentally. On raspberry, the eggs are laid singly on the current year's cane, usually on the upper half, and always either at the junction of a petiole with the cane or between the axillary bud and the cane. In 1937 and 1938, the first young Aphids were observed in mid-March, and hatching was complete by early April. The fundatrices mature about a month after hatching, when the fruiting laterals have developed and the young blossom buds are free from unfolding leaves. They and their progeny migrate from leaf to leaf and congregate in large colonies round the stalks of the cluster of fruit buds. They are constantly attended by ants. The first and second generations are apterous, but most of the third are alate. These alate viviparae first appear at the beginning of June, are most numerous a month later and disappear at the end of July or in early August. They do not migrate to an alternate food-plant, but disperse chiefly to the young raspberry canes, where they feed singly on the lower surfaces of the leaves. Their progeny are apterous viviparae, and no other forms are produced until early October, when sexuales appear. By November, only the sexual forms are present, and these persist in diminishing numbers until the canes have lost all their leaves (about mid-December).

The other species of *Aphis* is a dark green form that has been observed on cultivated blackberry and also attacks plants of blackberry parentage, a list of which is given. It was at first thought to be *A. urticaria*, Kalt., but attempts to establish it on *Urtica urens*, which is one of the known food-plants of this species, were unsuccessful. Its life-cycle resembles that of *A. idaei*, but all generations are gregarious. Alate viviparae are produced in June–July and migrate to other blackberry plants, while oviparous females and alate and apterous males are present from October to December. A species of *Aphidius* is commonly found parasitising it, sometimes destroying 80 per cent. of the population. Other Aphids observed on *Rubus* include *Macrosiphum solanifolii*, Ashm. (*gei*, auct.), which has been noticed of recent years breeding viviparously on Lloyd George raspberries from October or November until the canes lose their leaves. In December 1938, alate viviparae occurred in one colony. Small numbers of *M. solani*, Kalt. (*Myzus convolvuli*, Kalt.) have also been observed on raspberry. *Myzus ornatus*, Laing, was numerous on Himalaya blackberry in the spring of 1936, when alatae appeared in March and migrated, and some individuals were observed on wild blackberry in June 1937.

All the Aphids on *Rubus* are attacked by predators. Larvae of *Coccinella septempunctata*, L., *Adalia bipunctata*, L., Syrphids and Neuroptera are present from April until the end of July. The Syrphid

and Neuropterous larvae persist in diminishing numbers until autumn, but during this period predacious Rhynchota such as *Anthocoris nemorum*, L., *A. nemoralis*, F., *Orius* (*Triphleps*) *majusculus*, Reut., *O.* (*T.*) *minutus*, L., and Capsids are active and persist until October.

The statistical validity of the sampling methods employed in the population studies, the possibility that Aphids may be concerned in the transmission of virus diseases of *Rubus*, and (in an appendix) the origin of some of the cultivated forms of *Rubus* are briefly discussed.

MARTIN (H.). **The Incorporation of direct with protective Insecticides and Fungicides. IV. The Evaluation of the wetting and spreading Properties of Spray Fluids.**—*J. Pomol.* **18** no. 1 pp. 34–51, 11 refs. London, 1940.

The following is the author's summary of this paper, which is the fourth of a series [*cf. R.A.E.*, A **26** 370, etc.] : The purpose of the investigation was to devise a laboratory method suitable for the assessment of the wetting and spreading properties of spray fluids. Twenty different water-soluble products of potential value as spray spreaders, all containing active constituents of long-chain structure, were examined, and analytical data are given. The surface tension of solutions of these products, the area of spread of droplets of constant volume and the contact angles and retention on standard surfaces are recorded. It is shown that many surface-active substances yield solutions exhibiting advancing and receding contact angles in similar linear relationship, provided that the receding angle has a finite value. The existence of important exceptions to the rule is justification for considering the receding and advancing angle as distinct entities, though intermediate values are to be expected in spray practice.

The area of spread of droplets on a particular surface is related to functions both of the contact angle and of the spreading coefficient on that surface. Correlations of similar significance result when either advancing or equilibrium contact angle is used in these functions. Experimental difficulties with small droplets and uncertainty of the contact angles assumed by larger droplets render the assessment of area of spread of doubtful value in assessing wetting and spreading properties. The maximum initial retention is determined by contact angle and by spreading coefficient ; correlations of similar degrees of significance are obtained when either receding contact angle or equilibrium contact angle is used in the estimation of the correlation coefficients. The relationships between area of spread, or maximum initial retention, and contact angles, or spreading coefficient, exist not only for surface-active compounds of similar structure, but also for spreaders of diverse molecular structure.

It is shown that among commercial products based on sodium dodecyl sulphate, the content of alkyl sulphate determined by analysis is an unreliable guide to the spray performance of the product. Evidence is given that the estimation of maximum initial retention and observation of the character of the spray deposit are criteria for the evaluation of spray spreaders, and that the method is also suitable for the examination of the wetting and spreading properties of multiphase sprays and for the routine standardisation of the wetting and spreading properties of compounded products.

Germany. The Colorado Beetle Situation in 1939.—*Int. Rev. Agric* **31** no. 3 pp. 49M–50M. Rome, 1940.

This is a further report [*cf. R.A.E.*, A **28** 296] of the distribution of the Colorado potato beetle, *Leptinotarsa decemlineata*, Say, in Germany in 1939. During the year, it occurred in 12,206 places and 2,381 communes in Prussia, Bavaria, Württemberg, Hesse, Baden and Saarland, and upwards of 51,000 adults, 25,000 egg clusters, a million larvae and 13,900 pupae were found. The dates on which the first examples of each stage were observed are given, with the localities in which they occurred [*cf. loc. cit.*]. Adults were rare until 20th May; the first adults of the summer generation were observed on 10th July and the last on 13th November.

AYOUTANTIS (Q.). **Greece. Control of the Olive Fly.**—*Int. Rev. Agric.* **31** no. 3 pp. 50M–55M. Rome, 1940.

During 1938, a campaign was carried out in Greece against *Dacus oleae*, Gmel., on olive in districts in which the expense was justified by the expected harvest. A list of districts is given in which a total of 26½ million trees, giving, in general, 30 per cent. more than the average yield, were treated. Bait-sprays containing 10–15 per cent. sugar-cane molasses, 2·5 per cent. sodium arsenite and 5 per cent. ammonium sulphate were applied on dates determined by the use of glass traps (1 per 50–200 trees) containing 10–15 per cent. molasses, 0·5 per cent. sodium arsenite and 0·5 per cent. ammonium sulphate or a solution of 5 per cent. ammonia in water which were inspected every 5 days. As the spray had scorched the leaves and fruits in previous years, particularly on trees requiring repeated applications, it was applied to bundles of twigs hung in the trees.

The organisation and cost of the campaign and the resulting increase in production of oil and olives are discussed. Estimates by managers of agricultural banks who took into consideration the yields in treated and untreated areas indicate that the increase in quantity and quality of the crops represented an increase of well over 50 per cent. in their value as a result of the control of the fly. This increase in value was about 12 times the total cost of the campaign. The preliminary results of experiments for the improvement of control methods showed that sugar-beet molasses was much more attractive than cane molasses to *D. oleae* when used in the bait-traps.

AYOUTANTIS (A.). **Greece. Scale Insects observed on *Citrus* Trees in the Islands Skiathos, Skopelos and Sakiz-Adasi.**—*Int. Rev. Agric.* **31** no. 4 p. 75M. Rome, 1940.

The results are given of a survey by J. Koronéos of the Coccids that occur on *Citrus* in the Islands of Skiathos, Skopelos and Chios (Sakiz-Adasi). *Aonidiella aurantii*, Mask., which was the most common species, *Coccus* (*Lecanium*) *hesperidum*, L., *Saissetia oleae*, Bern., and *Pseudococcus citri*, Risso, occurred on all three Islands, *Icerya purchasi*, Mask., was observed on Chios, and *Lepidosaphes beckii*, Newm. (*pinnaeformis*, Bch.) was found in one locality on Skiathos, having undoubtedly been introduced with *Citrus* trees or cuttings. *Chrysomphalus dictyospermi*, Morg. [*cf. R.A.E.*, A **28** 456] was not found on any of the islands.

GILLEN (M.). **Luxemburg. The Colorado Beetle Situation during 1939.** —*Int. Rev. Agric.* **31** no. 4 p. 76M. Rome, 1940.

During 1939, 238 foci of *Leptinotarsa decemlineata*, Say, were reported in Luxembourg. This was only a few more than in 1938, but the extent of each was much greater. Infestation of potato was more severe in only a few localities, however, and no important damage was reported. Beetles were first observed on 10th and 18th April, emerging from hibernation. Scattered foci appeared in the first half of June, after which the number increased rapidly for a time. Only scattered foci were found during August, but a very important one, which must have been in existence for some time, was found in September, when the potatoes were lifted. Only two were reported from the northern part of the country (Ardennes region), where there had been many in 1938. The majority of the infestations occurred in light, sandy or well cultivated soils, into which the beetles can penetrate deeply before hibernation for protection against the cold.

WAHLEN (F. T.). **Switzerland. Distribution of the Colorado Beetle and Organisation of Control Measures against this Pest.**—*Int. Rev. Agric.* **31** no. 4 pp. 79M–81M. Rome, 1940.

In 1939, *Leptinotarsa decemlineata*, Say, was first found in the field in Switzerland at the end of May, but had been found earlier in imported vegetables. It spread considerably during June and July, reaching the canton of Valais at the end of June [*cf. R.A.E.*, A **27** 350], those of Schaffhausen, St. Gall and Zug at the beginning of July, Obwalden in mid-July and the cantons of Schwyz and Thurgau at the end of the month, when the first beetles had probably crossed the whole country. The stages of development observed in the cantons of St. Gall and Schwyz suggested that the beetles that had penetrated furthest east had been carried on the west wind at the beginning of July. Stormy weather induces them to swarm and allow themselves to be carried on the wind, and swarms were observed in western Switzerland. Females of the summer generation had begun to oviposit by the middle of August, but became less active and penetrated into the ground early on account of cold and wet autumn weather.

At the end of the year, 39,300 foci had been reported from 1,496 communes ; the numbers for each of the 18 cantons from which the beetle was recorded are shown in a table. It is now considered that there is no prospect of eradicating it from Switzerland, and the measures taken against it have therefore been simplified. Soil fumigation with carbon bisulphide is confined to isolated foci, and even spraying is made compulsory only at the request of a severely infested commune. A mixed spray is recommended, consisting of Bordeaux mixture (against potato blight) and lead arsenate. Places where the insects are actually found should be treated with derris powder to kill any larvae falling to the ground. This treatment is the only one possible where there is a danger of poisoning vegetables.

JEPSON (W. F.). **Entomological Division.**—*Rep. Dep. Agric. Mauritius 1938* pp. 40–51. Port Louis, 1939. [Recd. 1940.]

In 1938, infestation of sugar-cane by larvae of *Lachnosterna* (*Phytalus*) *smithi*, Arr., in Mauritius showed a general decrease in

intensity, except in one area, where it is still serious. The Scoliid, *Campsomeris phalerata*, Sauss., which is the most important of the established parasites of the larvae [*cf. R.A.E.*, A **28** 243], increased considerably, and its intensive distribution was continued. *Scolia carnifex*, Coq., which was introduced from Madagascar in 1935, was recovered repeatedly on one estate in March. Most of the information on the importation of parasites in 1938 has already been noticed [*cf.* **28** 303]. *Cordia* is being generally replaced as a food-plant for the adult Scoliids in sugar-cane fields by *Stachytarpheta indica*, which is equally attractive, does not invade the fields and is easily disposed of when necessary. *Eupatorium pallescens* is flourishing in one district, where it attracts many Scoliids, and plants and cuttings have been distributed. It is a soft-wooded species that shows no tendency to invade the cane fields. *Bufo marinus* was introduced in January from Porto Rico against the Melolonthid, and liberation was begun in December. In the search for canes showing economic resistance to heavy infestation by the larvae, the varieties 73/31, 72/31 and 108/30 gave significantly higher yields than others, and 73 31, P.O.J. 2878 and P.O.J. 2727 were significantly less infested. Varieties that give a tolerable yield on highly infested land include M.27/16, P.O.J. 2878 and 108/30, of which the last is useful in extreme cases, where its low sugar content is counterbalanced by its ability to give high tonnage.

Infestation by sugar-cane moth borers, chiefly *Diatraea mauriciella*, Wlk. (of which *D. venosata*, Wlk., is considered a synonym), remained nearly constant, though there were severe local losses in northern districts during an abnormally dry period from August to November. *Apanteles flavipes*, Cam., is the commonest larval parasite of *D. mauriciella* in Mauritius, and has been found in up to 50 per cent. of the borer material collected in infested fields during November–December. Other pests of sugar-cane were *Trionymus* (*Pseudococcus*) *sacchari*, Ckll., which damaged young sprouting shoots on two occasions during the year, *Chionaspis* (*Aulacaspis*) *tegalensis*, Zehnt., and *Marasmia trapezalis*, Gn. [*cf.* **28** 244].

Fumigation with hydrocyanic acid gas obtained from Cyanogas G granules used at the rate of 2 lb. per 1,000 cu. ft. gave fair control of *Lasioderma serricorne*, F., in tobacco stores, though two, and in one case three, applications were necessary within 15 months ; it is hoped to reduce the cost and increase the effectiveness of the treatment by generating the gas by the pot method. Weekly dusting with pyrethrum powder was carried out in all stores. Observations showed that *L. serricorne* has 4–5 generations during the year ; the adults of the largest, which develops in late summer, are present in the early winter months (April–June). Since the number of larvae in a heavily infested bale rarely exceeds 500, whereas in experiments the progeny of one pair of beetles was over 2,000 after 4 months, it appears that infestation may result from oviposition by a single female. The existing stores in Mauritius have poorly constructed doors and windows, and the ingress of the beetles, which breed in stored products such as dried fish, saffron and sugar in neighbouring shops, cannot be prevented. *Thaneroclerus buqueti*, Lef., is an important predator of *L. serricorne*, though it does not normally exert effective control until after the tobacco is damaged. This Clerid apparently has a winter generation that lasts 7 months and of which the adults emerge about November, and two summer generations, each lasting about $2\frac{1}{2}$ months.

A larva of the winter generation may consume over 200 individuals, and one of a summer generation 40–60. Attempts are being made to rear the Clerid for timed release in infested stores.

The termites chiefly concerned in damage to building timbers in Mauritius are the dry-wood termite, *Calotermes* (*Cryptotermes*) *pallidus*, Ramb., and the subterranean species, *Eutermes* (*Nasutitermes*) *voeltzkowi*, Wasm., and *Heterotermes philippinensis*, Light, which is particularly destructive. A proprietary organic powder injected into the runways or nests has been found highly effective for the control of the subterranean termites.

Pineapple was attacked by the Coccids, *Pseudococcus brevipes*, Ckll., which was shown to be the cause of pineapple wilt [*cf.* **28** 145] and is preyed on by the Coccinellid, *Scymnus mauritiusi*, Korsch., and the larvae of a Cecidomyiid, and *Diaspis bromeliae*, Kern. The latter was largely controlled by a Chalcidoid parasite, and was readily attacked by the Javan Coccinellid, *Chilocorus politus*, Muls., which has become established on one estate on which it was liberated in 1937 [*cf.* **27** 611]. Control of *Icerya seychellarum*, Westw., which is particularly injurious in dry seasons to young plants of litchee, mango and *Citrus*, was obtained in several cases by spraying the older foliage thoroughly with a 2 per cent. emulsion of crude Diesel oil; this emulsion should not be applied to young leaves, as it scorches them. The Coccinellid, *Rodolia chermesina*, Muls., affords complete control of the Coccid if the trees are kept banded against ants. A further shipment of *Rodolia* (*Vedalia*) *cardinalis*, Muls., was received from South Africa [*cf.* **27** 611], three generations were reared in the laboratory, and over 1,000 adults were released in the field. Numerous reports were received in April–July of damage to turf by *Crambus emmerezellus*, de Joannis. Attack by this Pyralid can be prevented on small areas by spraying at fortnightly intervals from about 1st April with a suspension of lead arsenate (2 lb. per 100 gals. water); existing infestations can be controlled by the same means or by thorough watering with a suspension (5 lb. per 100 gals. water) of pyrethrum powder containing 0·73 per cent. pyrethrin I. Regular treatment of the turf during the late growing season with ammonium sulphate increases its resistance to attack.

An experimental plantation of *Derris elliptica* yielded per acre, under unfavourable conditions, nearly 15 cwt. dried root containing 3·6 per cent. rotenone. Experiments showed that the ground root was highly toxic to adults of *Lasioderma*, *Bruchus* spp. and *Brontispa limbata*, Waterh. Suspensions in water (5 lb. per 100 gals.) successfully controlled *Aphis tavaresi*, Del G., on *Citrus*. A nicotine-soap solution made by soaking about 1 lb. tobacco waste for 36 hours in 1 gal. water, straining and adding nearly 1 oz. soap, previously dissolved, gave effective control of Aphids on rose and *Citrus*.

A list of miscellaneous pests recorded during the year is appended.

Jones (E. P.). **Entomological Review, 1937.**—*Publ. Brit. S. Afr. Co.* no. 7 pp. 1–9, 3 refs. Oxford, 1939. [Recd. 1940.]

Damage by insect pests to the 1937 crop of *Citrus* on the estates of the British South Africa Company in Southern Rhodesia was comparatively small. Infestation by *Aonidiella aurantii*, Mask., was mild, and was so effectively controlled by fumigation with hydrocyanic acid gas that it caused a negligible loss of fruit. The loss due to fumigation injury was, however, greater and more widespread than in

previous years [*cf. R.A.E.*, A **27** 15]. The beginning of fumigation was delayed in order to avoid the high temperatures and relative humidities of the transitional period between summer and winter [*loc. cit.*], but the results of the treatment appeared to indicate that high temperature and humidity were not the cause of the injury, but merely influenced its extent, as injury occurred on several occasions when both were low. The trees first appeared to be susceptible to fumigation in about 1935 [*cf.* **25** 533], and their susceptibility seems to be increasing. It is considered probable that this is a direct result of several modifications in cultural and fertilising practices introduced during the last few years. For example, since the substitution of basin irrigation for furrow irrigation, the interval allowed after irrigation for the grove to dry up sufficiently to be fumigated may be insufficient.

Infestation by *Scirtothrips aurantii*, Faure, was exceptionally mild, and was successfully controlled by one application of a spray of colloidal sulphur and lime-sulphur or two of lime-sulphur alone [*cf.* **24** 609]. Attack by *Heliothis armigera*, Hb., was of an exceptional nature in August and September 1936, in that oviposition took place over a more protracted period than in previous years. Instead of a single peak period of oviposition at the end of August and beginning of September, two periods of equal intensity occurred, the second towards the end of September. Daily records of eggs collected indicated that the attack was not of a serious nature, and the loss of fruit was much less than was originally expected. Rainfall during the last week in August may have caused the second flight of moths by stimulating the overwintering pupae to complete development and facilitating the emergence of the moths from the soil.

A heavy localised infestation by *Coccus* (*Lecanium*) *hesperidum*, L., occurred during January and February, but towards the end of January, it was found that 70·2 per cent. of the scales were parasitised by 6 species of Chalcidoids [*cf.* **27** 15]. Predators were also active, and the infestation was reduced to a negligible amount by the middle of March. The false codling moth [*Argyroploce leucotreta*, Meyr.] was moderately abundant in a part of the Mazoe estate during July and August, and caused a loss of 1·5 per cent. of the fruit.

Jones (E. P.). **The Biology of a Tachinid Parasite** (*Sturmia rhodesiensis*, **sp.n.**) **of the Cotton Boll Worm** (*Heliothis armigera*, **Hübn.**) **in Southern Rhodesia.**—*Publ. Brit. S. Afr. Co.* no. 7 pp. 11–34, 4 pls., 4 refs. Oxford, 1939. [Recd. 1940.]

Detailed descriptions are given of the male and female adult, male terminalia, egg, three larval instars, puparium, internal anatomy of the larvae and reproductive systems of both sexes of a species of *Sturmia* parasitising *Heliothis armigera*, Hb., in Southern Rhodesia. The name *S. rhodesiensis*, sp.n., is proposed for it in the text, but it is pointed out in a footnote that it was described by Curran as *S. halli* [*R.A.E.*, A **27** 567] while this paper was in the press. Data on its biology are summarised from observations made during 1934–38. Males and females live for 6–22 and 12–33 days, respectively, when provided with food, but neither sex survives for more than 5 days without food. Females do not mate readily until 3 days or more after emerging, and oviposition occurs at least 7 and usually 10 days later. A female produces about 150 eggs. When larvae of *H. armigera* are

numerous, 1 and occasionally 2 or 3 eggs are deposited in one host, but when the number of larvae is limited, the number of eggs per host is greatly increased. An unparasitised larva left overnight with a solitary mature female of *S. halli* contained 23 living larvae in the first instar 4 days later. Only 1 parasite larva completes its development in each host. The host larvae are usually attacked during their fourth larval instar, but may be successfully parasitised from the end of the third instar to the middle of the sixth. The parasite larva enters the host within 15 minutes of the deposition of the egg ; the way in which it develops within it is described. The host, which usually dies a short time before the parasite larva emerges, always reaches the end of the sixth instar or the pupal stage. The parasite almost invariably emerges to pupate ; in only two cases was the puparium formed within the host pupa, and in both the host was overwintering. The larval stage lasted 16–20 days during October and November, and the pupal stage 9–18 days during September–November.

S. halli, together with *S. inconspicua*, Mg., is found parasitising the larvae of *H. armigera* by the second week in September, one or two weeks earlier than other Tachinid parasites. It passes through several generations during the summer and is active until the end of April or beginning of May. It overwinters in the pupal stage, which lasted 99–175 days in the winter of 1936. Adults emerged between 15th August and 22nd October from 25 puparia found between 25th April and 18th May. Three other puparia formed early in May gave rise to adults after 26–38 days. In 1934–38, the percentage parasitism of *H. armigera* by *S. halli* was 14·7–24·8 when it was infesting *Citrus* in September and October, and 3·0–4·8 during its last summer generation on maize, sunflower, sunn hemp [*Crotalaria juncea*], beans and other vegetable crops. In both periods, *S. halli* was one of the most active of the Tachinid parasites of *H. armigera* ; it was not found to attack any other host.

Smith (J. H.). **Report of the Entomological Section.**—*Ann. Rep. Dep. Agric Stk Qd. 1938–39.* pp. 32–35. Brisbane, 1939. [Recd. 1940.]

In 1938–39, the incidence of certain insect pests in Queensland was unusual, owing to heavy winter and spring rains having preceded the normal wet season, which was broken by hot dry weather in January. *Cydia pomonella*, L., caused much damage to apples in one district, and unsettled weather interfered with spraying. Experiments showed that the most effective spray programme for its control comprised a calyx spray of lead arsenate followed by cover sprays of 1½ gals. white oil and 1 pint nicotine sulphate in 80 gals. water [*cf. R.A.E.*, A **27** 89] applied at intervals of 3 weeks or timed by bait traps. *Dacus* (*Chaetodacus*) *ferrugineus tryoni*, Frogg., increased in numbers on deciduous fruits in early spring and summer. Bait-sprays containing tartar emetic, sodium fluosilicate or lead arsenate each resulted in considerable reductions in infestation on plums, compared with unsprayed orchards. Pests of strawberry included *Anaphothrips* (*Neophysopus*) *fragariae*, Gir., which was proved by experiments to cause russetting of the fruits, and *Tortrix postvittana*, Wlk., which injured the leaves on the north coast. The number of banana plantations on which measures against *Scirtothrips signipennis*, Bagn., were necessary increased during the year. Attempts to find a cheap substitute for the hessian bags previously recommended for enclosing

the bunches of fruit [**26** 211] showed that paper bags impregnated with preservatives were not resistant to the weather, but tubes of hessian that could be tied at the end to form a bag were effective. A large consignment of the predacious Hydrophilid, *Dactylosternum hydrophiloides*, Macleay, was introduced from Malaya [*cf.* **28** 322] against the banana weevil borer [*Cosmopolites sordidus*, Germ.] and liberated in a banana-growing area. Later observations showed that one generation had been completed in the field, though the numbers present were small. Fruit-piercing moths, including *Othreis fullonia*, Cl. (*fullonica*, L.), caused extensive loss of *Citrus* in the central and southern coastal fruit areas in 1938, but were less important in 1939, though losses in districts in the central-west and far north were still greater than they had been for some years. The outbreak in central districts was correlated with heavy larval populations on a native vine (*Legnephora moorei*) that is widely distributed in coastal and subcoastal areas. *Amblypelta lutescens*, Dist., damaged papaya in one district, especially plants not making rapid progress. Correctly timed applications of nicotine dusts appear to give satistactory control. *Rhoecocoris sulciventris*, Stål, caused severe damage to fruits and young growth of *Citrus*. The standard spray of resin, caustic soda and fish oil [*cf.* **19** 714] was applied in autumn, when the Pentatomid is most vulnerable.

Vegetable pests included *Agromyza phaseoli*, Coq., on beans [**28** 332] and *Nezara viridula*, L., which was abundant in parts of southern Queensland. The introduced egg parasite, *Microphanurus basalis*, Woll., appeared to be exercising some control of the latter [*cf.* **27** 603]. This Scelionid was released in three localities in central and northern Queensland, where the bug has caused losses of recent years, and was recorded from a district in southern Queensland about 200 miles from the nearest point of liberation. It is assumed that spread was effected through movement of vegetables bearing parasitised eggs.

A Cecidomyiid, possibly identical with the American sorghum midge, *Contarinia sorghicola*, Coq., was very destructive to the grain types of *Sorghum* in one locality. Observations indicated that it is common and injurious in all districts in which *Sorghum* is grown. A widespread outbreak of *Cirphis unipuncta*, Haw., occurred in spring and caused considerable damage to winter cereals, but, owing to abundant rain, most of the crops recovered rapidly. Sporadic outbreaks of *Penthaleus bicolor*, Frogg., occurred on wheat and oats on the Darling Downs. Cotton pests included *Empoasca terrae-reginae*, Paoli, *Cosmophila* (*Anomis*) *flava*, F., and *Platyedra scutigera*, Hold., all of which were numerous late in the season. Populations of *Heliothis armigera*, Hb., were drastically reduced in most districts by the hot dry weather in December and January.

Seed-harvesting ants have for some years caused considerable loss on both alluvial and scrub-soil land to Rhodes grass [*Chloris gayana*] in pastures. *Pheidole impressiceps*, Mayr, appeared to be the dominant species at Biloela. The selection of suitable cultural practices and some of the more desirable seed treatments would probably reduce losses appreciably. Tar derivatives were the most promising of the repellents tested for seed treatment. Larvae of the Pyralid, *Psara licarsisalis*, Wlk., which is generally distributed throughout the State but seldom economically important, were widespread in autumn in pastures in southern Queensland, but were controlled by means of an arsenical-bran bait. The infestation was preceded by an outbreak of *Laphygma*

(*Spodoptera*) *exempta*, Wlk., in one district. The Tineids, *Philobota productella*, Wlk., and *P. diaereta*, Turn., caused localised injury to pasture on the Darling Downs. *Agrotis ypsilon*, Hfn., attacked lucerne extensively in southern Queensland, and also autumn-planted cereals and vegetables. An indigenous Noctuid of the genus *Hypena* caused complete defoliation of an area of the noxious weed, *Lantana* [*camara*], but the larvae and pupae were very heavily parasitised, and their abundance is considered to be the result of a temporary lack of balance between host and parasites.

Since infestation of milled timber by *Lyctus brunneus*, Steph., has been shown to be dependent on the starch content of the wood [*cf.* **24** 372], methods of reducing the starch in the bole of the tree before felling were investigated. Tests on spotted gum [*Eucalyptus*] indicated that ring-barking above the level of profitable utilisation may lower the starch content sufficiently in about 6 months to prevent attack. Two years' investigations on the weevil, *Aesiotes notabilis*, Pasc. [which attacks hoop pine (*Araucaria cunninghami*)] showed that the rain-forest temperature in all parts of the State favours development throughout the year, though activity is greatest in wet weather [*cf.* **27** 603]. If thinning and pruning are carried out in dry winter or spring weather, bole injury by the weevil should be negligible. Infestation by borers, chiefly *Platypus australis*, Chap., and *P. froggatti*, Samps., was conspicuous in the Killarney logging area ; co-ordination of logging and milling, so that the damage caused before the logs are used is kept to a minimum, is considered preferable to treatment of the logs with insecticides. Annual applications of a solution of equal quantities of creosote and kerosene by injection or by brushing will normally eradicate the Queensland pine beetle, *Calymmaderus incisus*, Lea, from constructional timber of hoop pine. The Buprestid, *Prospheres aurantiopictus*, Lap. & Gory, which infests logs of this tree soon after they are felled, often emerged from the timber in newly constructed dwellings. Injury was caused in a forest nursery to the roots and stems of hoop-pine tubed nursery stock by a weevil, *Tyrtaeosus microthorax*, Pasc., the larvae of which burrow to considerable depths within the roots.

The Lycaenid, *Candalides absimilis*, Fldr., and the Lymantriid, *Orgyia australis*, Wlk., are pests of the *Macadamia* nut, and are likely to become more important as the area under this crop increases.

Papers noticed by Title only.

Corbett (G. H.). **A new Species of Aleurodidae from India** [*Aleurocanthus husaini*, sp. n., on *Citrus* in Punjab].—*Indian J. Ent.* **1** pt. 3 pp. 69–70, 5 figs. New Delhi, 1939. [Recd. 1940.]

Zacher (F.). **Die Fauna der Mühlen und Speicher in Aegypten.** [The Fauna of Grain Mills and Warehouses in Egypt (a list of 142 Arthropods).]—*VI Congr. int. Ent. Madrid 1935* **1** pp. 353–368. Madrid, 1940. [*Cf. R.A.E.*, A **27** 219.]

Garman (P.). **Tetranychidae of Connecticut** [including three new species].—*Bull. Conn. agric. Exp. Sta.* no. 431, 88 pp., 23 figs., 1 ref. New Haven, Conn., 1940.

Roark (R. C.). **Review of United States Patents relating to Pest Control** [January–June 1940] **13** nos. 1–6 ; 10, 13, 9, 10, 11, 9 pp. multigraph. [Washington, D.C.] U.S. Dep. Agric. Bur. Ent., 1940.

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BULLETIN AGRICOLE DE L'ALGÉRIE—TUNISIE—MAROC (ALGIERS):
Année XX (1914). Nos. 7–9, 12–14 and Title-page.

BULLETIN DU COMITÉ D'ETUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (PARIS): Année 1919, No. 1.

CALIFORNIA AGRICULTURAL EXPERIMENT STATION (BERKELEY, CAL.):
Circulars 14 and 42 (1905–09).

CHACARAS E QUINTAES (SÃO PAULO): Indices to Vols. X, XI, XII, XIV and XLII, No. 3.

COMPTES RENDUS DES SÉANCES DE L'ACADÉMIE D'AGRICULTURE DE FRANCE (PARIS): Tome VIII (1922) No. 5.

EGATEA, REVISTA DA ESCOLA DE ENGENHARIA DE PORTO ALEGRE, BRAZIL:
Vols. I–VI (1916–21); VII (1922) Nos. 1–5; VIII (1923) Nos. 2–5; IX (1924) Nos. 1, 4–6.

ENTOMOLOGICA AMERICANA (BROOKLYN, N.Y.):
Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.

ENTOMOLOGISCHE LITTERATURBLÄTTER (BERLIN): 6. Jahrg. (1906). Nos. 2 & 10.

EXPERIMENT STATION RECORD (WASHINGTON, D.C.): Vols. I–IV (1889–94).

GEORGIA STATE BOARD OF ENTOMOLOGY (ATLANTA):
Bulletin: 2, 6, 22 and 28. Circular: 1 to 3, 12, 15 to 18 and 20.

INDIA: FOREST RESEARCH INSTITUTE (DEHRA DUN):
Forest Bulletin (Old Series): Nos. 1–3.

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INDIANA : Third Annual Report of the State Entomologist, 1909–10.

JOURNAL OF THE BOARD OF AGRICULTURE OF BRITISH GUIANA (DEMERARA) :
Vol. III No. 1 (1909). Title pp. and Indices to Vols. I–II.

JOURNAL OF THE SOUTH-EASTERN AGRICULTURAL COLLEGE (WYE, KENT) :
Nos. 1–6, 8, 11–13 (1895–1904).

KENTUCKY AGRICULTURAL EXPERIMENT STATION (LEXINGTON, Ky.) :
Bulletin Nos. 21 (1889), 31 (1890), 47 (1893), 53 (1894), 74 (1898) and 91 (1901).

THE KENYA AND EAST AFRICAN MEDICAL JOURNAL (NAIROBI) : Vol. II Nos. 2–3 (1925).

NATUURHISTORISCH MAANDBLAD (MAASTRICHT) : Jaarg. I (1912) ; II (1913) Nos. 1–4, 6–9 ; V (1916) Nos. 3–4 ; VII (1918) Nos. 6–9 ; VIII (1919) No. 4.

NEW JERSEY STATE DEPARTMENT OF AGRICULTURE (TRENTON, N.J.) : Bulletin 2 ; Circular : 2, 12, 29 (1917–19).

NEW YORK STATE MUSEUM (ALBANY, N.Y.) : Bulletin : 26 & 57 (1899–1902).

ONTARIO ENTOMOLOGICAL SOCIETY REPORT (TORONTO) : 9th (1878).

ORMEROD (E. A.). OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS DURING THE YEARS 1877 & 1878 (London, 1878–79).

PHILIPPINE AGRICULTURIST AND FORESTER (MANILA) :
Vols. II Nos. 1–3 (1912) ; III Nos. 1, 2 (1914) ; IV No. 4 (1915).

PHILIPPINE JOURNAL OF SCIENCE (MANILA) : Vol. I (1906) No. 10.

PORTO RICO DEPARTMENT OF AGRICULTURE, &c. (SAN JUAN) :
Journal, Vol. I (1917) No. 3.

PSYCHE (BOSTON, MASS.) : Vols. XI (1904), XIII (1906), XVI (1909).

RECORDS OF THE EGYPTIAN GOVERNMENT SCHOOL OF MEDICINE (CAIRO) : Vol. I.

REVISTA DE AGRICULTURA DE PUERTO RICO (SAN JUAN) :
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Annos I–II (1911–12). Anno III (1913) Nos. 1 to 3, and 5.

LA REVUE DE PHYTOPATHOLOGIE APPLIQUÉE (PARIS) : Tome I Nos. 22–23 (April–May, 1914).

RHODESIA AGRICULTURAL JOURNAL (SALISBURY) :
Vol. I Nos. 1, 3–6 ; II Nos. 2–4 ; III Nos. 1, 2, 6 ; IV No. 4 ; V No. 4 (1903–08) ; VII (1909–10) Nos. 1 & 6 ; IX (1912) No. 5 ; X (1912) No. 1. Title pp. and indices to Vols. I–V, VII, VIII, X.

SCIENCIA MEDICA (RIO DE JANEIRO) : Anno 1 Nos. 2–3, 5–6 ; II Nos. 1–10, 12.

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY :
Report, 1879–84.

TENNESSEE AGRICULTURAL EXPERIMENT STATION (KNOXVILLE) :
10th (1897), 12th (1899), and 16th (1903) Annual Reports.

TENNESSEE STATE BOARD OF ENTOMOLOGY (KNOXVILLE) :
Bulletin : 15, 24, 25, 28, 29, 34, 39.

TEYSMANNIA (BATAVIA) : 32ste Jaarg. (1921) 10e Afl.

DE THEE (BUITENZORG) : 6e Jaarg. (1925) No. 1.

TIJDSCHRIFT OVER PLANTENZIEKTEN (WAGENINGEN) :
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TIMEHRI : THE JOURNAL OF THE ROYAL AGRICULTURAL AND COMMERCIAL SOCIETY OF BRITISH GUIANA (DEMERARA) :
Third Series, Vols. I Nos. 1–2 ; II No. 2 to end ; III Nos. 2 to end ; IV–V (1911, 1913–18).

UNITED STATES DEPARTMENT OF AGRICULTURE (WASHINGTON, D.C.) :
Howard (L. O.). Report of the Entomologist, 1895.

VIRGINIA : AGRICULTURAL EXPERIMENT STATION (BLACKSBURG, Va) :
Bulletins 24, 61 (1893–96). Technical Bulletin 8 (1915).

VIRGINIA : 1st ANNUAL REPORT OF THE STATE INSPECTOR FOR SAN JOSÉ SCALE, 1896–97 (Richmond, Va, 1897).
4th Report of the State Entomologist and Plant Pathologist (Richmond, Va, 1905).

WEST INDIAN BULLETIN (BARBADOS) : Title-page & Index to Vol. IV.

ZEITSCHRIFT FÜR DAS LANDWIRTSCHAFTLICHE VERSUCHSWESEN IN ÖSTERREICH (Vienna) : 21. Jahrg. (1918) Hefte 1–3 & 10–12.

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